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AN EXPLORATORY INVESTIGATION OF THE EFFECTS

OF REWARD SCHEDULE CHANGES ON

CHILDREN'S SPEECH FLUENCY

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CHAPTER I

INTRODUCTION

Disfluency in the speech of young normal-speaking children has been and continues to be a major research interest of the speech pathologist in the diagnostic evaluation of children with fluency problems. The study of disfluency in normal-speaking children is important, also, because of the possible relationship between normal disfluency and stuttering. It has been suggested that disfluency in the stuttering child is merely an extreme degree of the same sort of disfluency in the speech of a nonstuttering child. There is, as Bloodstein (7) suggests, "much to be learned about the development of stuttering from research on normal nonfluency."

There seems to be general agreement that speech fluency in children is influenced by various situational factors. Time pressure, fear of interruption, inattentive listeners, extreme fatigue, discouragement, punishment, humiliation, and others have been mentioned as factors causing children to speak more disfluently. The knowledge that speech fluency is affected by various situational factors has led to the most widely accepted course of therapy for young children beginning to stutter. The rehabilitative process with these children consists in large part of parental counseling. One of the main goals in this counseling is reduction of those factors in the child's environment which cause disfluent speech.

One factor frequently mentioned in the literature as affecting speech fluency is that of frustration. In fact many of the environmental situations that cause children to become disfluent can be grouped under the general heading of frustrating situations. In spite of the frequent references to the deleterious effects of frustration on speech fluency, these effects have not been studied experimentally.

The difficulty in defining frustration in such a way as to be able to study its effects on speech is no doubt one reason for the lack of research in this area. In psychiatric terms frustration has been defined as "a deprivation which is also a threat to the personality, particularily to the self-esteem or feeling of security of the person" (85). Definitions of this type make controlled study of frustration effects difficult, if not impossible.

Frustration has been defined in several experimental studies as those responses which occur when the organism is blocked from a highly desired goal (5, 19, 28). More recently frustration has been viewed as the emotional response which occurs in an organism when nonreward follows a response that has previously been rewarded (1, 80). Nonreward in this type of situation has been referred to as "frustrative nonreward." If frustration results from the nonreward for a previously rewarded response, then frustration might be expected to occur when a subject is shifted from a continuous to a partial reward schedule. It would be hypothesized, therefore, that children switched from a continuous to a partial schedule of reward for speaking might exhibit higher disfluency rates on the partial than the continuous schedule, while children switched from a partial to a continuous schedule of reward for speaking would show little change in disfluency rate.

This investigation represents an exploratory attempt to determine the effects of changes from continuous to partial reward schedules and from partial to continuous reward schedules on the speech fluency of normal-speaking children.

CHAPTER II

REVIEW OF THE LITERATURE

Numerous investigators have studied speech disfluencies in young normal-speaking children (6, 10, 21, 22, 27, 30, 42, 55). While the procedures used have differed, it is possible to draw some limited conclusions from these studies.

Preschool children are disfluent on about five to seven of every 100 words spoken and frequency of disfluency tends to diminish with age (10, 22, 44, 55). Repetitions of phrases, words, and syllables are common in childrens' speech, especially between the ages of two to five years (21, 55). Phrase repetitions are the most frequent repetition type, syllable repetitions the least frequent repetition type with word repetitions falling in between. Repetitions also decrease with age (10, 21) although Davis (22) has stated that syllable repetitions are not affected by age. Finally, there is some evidence to suggest that boys are more disfluent than girls of the same age (30, 71).

Investigations have shown a similarity in the type and frequency of disfluencies emitted by stuttering and nonstuttering children. Johnson (42) found that children regarded by their parents as normal speakers and children regarded by their parents as stutterers spoke with similar types but with different degrees of disfluency. He felt that there is no sharp dividing line on the disfluency continuum that separates stutterers and nonstutterers, and that there is little difference in the speech of the most fluent stutterers and the least fluent nonstutterers. Similarly Bloodstein (8) has stated that "stuttering is essentially similar to certain forms of normal disfluency differing from them in degree more than in kind."

Other writers (9, 32, 89, 90) have taken the view that stuttering and nonstuttering may be differentiated by certain disfluency types. These researchers point out that part-word and syllable repetitions and prolongations are more often classified as stuttering disfluencies, while interjections and revisions are classified as normal disfluencies.

It is generally accepted that fluency is a speech parameter that shows considerable variation. Both adults and children, whether they are classified as stutterers or nonstutterers, are more disfluent in certain situations than others. Most investigations of the effects of situational factors on speech fluency, however, have involved adult subjects.

During recent years there has been interest in the relationship between speech disfluency and anxiety in studies using college-age or older subjects. Kasl and Mahl (47) demonstrated that speech disturbances of the non-ah type increase significantly with degree of anxiety, while the ah types of disfluency show no relation to degree of anxiety. Siegman and Pope (79) found that anxiety-arousing topics in an interview situation are associated with increased non-ah speech disturbances. Kasl (46) reported the occurrence of higher ah-ratios during an "Anger" interview than a "Neutral" interview. Feldstein and Jaffe (29), on the other hand, obtained results which suggested that the occurrence of ah or non-ah speech disturbances are not related to the experience of anger.

Other studies using adult subjects have dealt with the experimental manipulation of certain classes of verbal behavior. When the presentation of aversive stimuli such as electric shock (31, 76), verbal punishment (13, 77, 78), time-out from speaking (35), and noise (11, 12) have been made contingent on disfluency occurrence, adult normal speakers and adult stutterers have decreased their disfluency rate. It has also been shown that adult normal speakers and adult stutterers increase disfluency when aversive stimuli are presented randomly during speaking tasks. Hill (36) found that when electric shock was paired with a light during oral reading, subsequent presentation of the light alone (threat of shock) resulted in higher ratings of "disorganization" of speech. Savoye (70) had normal-speaking adults read for sixty minutes and each two minutes presented a tone followed by an electric shock. These randomly shocked subjects had significantly more disfluencies than nonshocked control subjects. Stassi (83) delivered the verbal stimuli "Right" and "Wrong" randomly following normal-speaking subjects' production of nonsense words. Subjects read various words under four reward schedules and were rated as being significantly more disfluent on reward schedules containing a greater percentage of punishments ("Wrongs"). Other investigations employing random presentation of electric shock (76) and noise (11, 12) have shown adult speakers to increase slightly disfluency rate.

A few investigators have studied the effects of situational factors on children's speech. It is difficult to generalize from these studies, however, since they differed in terms of age of subjects, speaking task, definition of disfluency, and other methodological aspects.

Davis (21, 22) abandoned an attempt to determine whether or not each instance of repetition in a free-play situation was accompanied by some factor or factors in the environment or situation because of the difficulty involved in distinguishing such factors. Egland (27) using normal-speaking children ranging in age from sixty to seventy-two months, obtained speech samples in five situations. Three of these were relatively neutral with regard to emotional factors, one involved speaking difficult polysyllabic words, and in the fifth the child had to give verbal support to a male puppet oppressed by a "villianous" puppet. Although the latter situation was designed to incite excitement in the subjects, the percentage of repetitions observed in this situation was lower than in other situations. The highest percentage of repetitions occurred in the polysyllabic situation.

Using children differing in levels of exhibitionism and audience anxiety, Paivio (58) studied the effect of a brief period of social isolation on the length of stories told by the children. There were no significant differences in story length between high and low exhibitionism groups or between isolated and non-isolated low anxiety groups. Nonfluencies in speech were reported as not significantly related to either personality variables or to experimental condition. Levin and Silverman (49) had children tell stories in each of two situations, to an audience of four adults and to a microphone while no one was listening. Prior to the speaking tasks indices of exhibitionism were derived for individual children on the basis of their responses to a thirteen-item questionnaire. The authors found that deliberate hesitations as opposed to stressful hesitations were predictable from the personality characteristic exhibitionism. Deliberate hesitations were characterized by a slow rate of speech, frequent repetition, and corrections of nonfluencies. Stressful hesitations were characterized by a high rate of zero segregates (unfilled pauses) and vocal segregates (filled pauses) with infrequent occurrence of repetition and correction and were found to be more prevalent when the child was speaking in public than in private. Levin, Silverman and Ford (50) showed children three simple physical demonstrations (for example, a helium-filled balloon rising and an air-filled balloon falling). Children were asked (1) to describe and (2) to explain what they saw. For children of all ages studied (grades kindergarten, 2, 4, and 6) explanation compared with description was characterized by more words, pauses, hesitations, longer pauses, and a slower rate of speaking.

While it is recognized that many factors may be responsible for increased disfluency in children, one factor which has been studied very little in this context and frequently mentioned in the literature as affecting speech fluency is frustration.

Schuell (71) for example in discussing the sex ratio in stuttering states that "a boy encounters more unequal competition, and consequently more frustrations, particularily in relation to language situations than the female child, and that as a result he exhibits more insecurity, more hesitancy, and more inhibitions in speech." Speaking of parent-child relationships Johnson (44) wrote, "Nothing is to be gained by making his (the child's) speech more nonfluent as a result of unnecessary frustrations and disapprovals." Sander (68) points out that speech situations will be less frustrating for the child if parents will refrain from interrupting him before he finishes his thoughts. He states that too much hurrying, stimulation, or excitement for the child is disrupting and should be avoided whenever possible. Van Riper (87) has said that stuttering becomes more frequent and becomes more severe when "frustrations of any type are experienced or remembered." He stated, also, "In counseling our parents we must help them understand the role of frustration in precipitating stuttering."

The adverse effects of frustration on speech fluency have not been demonstrated experimentally. Several studies used the Rosenzweig Picture Frustration Test, a projective test, to compare the verbal responses of adult normal speakers and adult stutterers to pictured frustrating situations (51, 54, 60, 72). These investigations did not involve placing subjects in actual frustrating situations and have in general yielded contradictory results. No studies have been done relative to the effects of frustration on the speech fluency of adults or children.

Many attempts have been made to study the effects of frustration on child behaviors other than speech (25, 34, 41, 92). In many of these studies and particularily the earlier studies, frustration was defined as those reactions observed when an organism is blocked from a desired goal (5, 28, 56, 93). Because of the variety of responses that can be elicited by goal-blocking, investigators, in these studies, have usually categorized types of frustration responses rather than quantifying numerically the strength of some response.

One of the earliest studies of children's responses to frustration in which an attempt was made to quantify results was that of Barker, Dembo and Lewin (5). These authors created a frustrating situation for children by allowing them to play with highly attractive and desirable toys before physically blocking the children from the toys by means of a wire screen. The child was thus in a position to see the toys but could not play with them because of the wire barrier. The portion of the room in which the child was placed contained some more ordinary toys with which the child had played in a previous nonfrustrating situation. The investigators used the proportion of time the children spent in barrier and escape behavior as an estimate of the potency of frustration. Barrier behavior referred to the amount of time spent by the children trying to gain access to the toys behind the screen while escape behavior referred to the amount of time the children spent trying to leave the situation. Constructiveness of play was rated in both the frustrating and nonfrustrating situations for each of the children. Barker, Dembo, and Lewin found that the children spent significantly more time in barrier and escape behavior, and regressed to lower age levels in terms of rated constructiveness of play in the frustrating situation.

Otis and McCandless (56) found that preschool children placed in an eight-trial frustration task in which they were prevented from completing travel with a toy car and a doll down a road constructed from preschool blocks showed significant increases in aggressive-dominant behavior scores from the first four to the last four trials, and showed decreases in submissive-complaisant behavior scores. Zunich (93) using as subjects three and four-year-old children studied behavioral reactions to failure on a puzzle task in relation to age and sex of the children. He found that most of the children attempted to solve the problem alone, but that three-year-olds more often sought assistance and four-year-olds exhibited more facial expressions and rationalizing behavior. Boys showed significantly more facial expressions, emotional-responses, rationalizing, and destructive responses, and sought help more often than girls. Girls showed more attempts to solve the problem alone and sought more information. Douglas (25) used a story-completion task in a developmental study of children's frustration responses. Each story revealed a child in a frustrating situation. The subjects, children eight to sixteen years old, were asked to provide the ending to the story. The subjects' story endings were judged by the experimenter to represent either denial of the frustrating state of affairs, rationalization, or realistic problem-solving. Douglas found that young children tend to be less realistic than older children when confronted with a frustrating situation, and that with increasing age children tend to rationalize more and more their disappointments.

Of frustration, Skinner (80) has said, "When we fail to reinforce a response that has previously been reinforced, we set up an emotional response. Perhaps this is what is meant by frustration." This limited definition of frustration is particularily advantageous in experimental studies because it permits the investigator to center his attention on one response class and "to quantify numerically" the strength of that response as a function of reward conditions. Amsel (1) points out that when reward is expected, nonreward is an active factor which he terms "frustrative nonreward." Amsel takes the view that "frustrative nonreward" has motivational properties which can be measured as an increase in the vigor of a response immediately following the nonreward event.

In a series of experiments in which rats were used as subjects Amsel and his co-workers (2, 3, 4, 62) have demonstrated the activating properties of nonreward. In all these studies the experimental situation was essentially the same. Rats were trained under hunger motivation to run down a runway (R1) to a goal box (G1) where they found food, then leave G1 and run down a second runway (R2) to a second goal box (G2) where they again found food. The time it took for the rats to traverse the distance along R2 to G2 was recorded over a series of trials until R2 running time had stabilized. Then a series of test trials were run, one half of which the rats were not rewarded in G1. The results of these studies indicated that nonreward (no food in G1) of the R1 response was followed by shorter R2 running times than those following reward of the R1 response. The difference between the vigor of performances following nonreward as compared with reward has been termed the "frustration effect."

A number of investigations using children as subjects support Amsel's findings with respect to the activating properties of frustrative nonreward (14, 37, 59, 63, 66, 88). In one group of investigations pairs of responses are made, the interest being in the strength of the second response as a function of whether the first response is rewarded or not rewarded. This procedure is similar to that used by Amsel except that with children different instrumental response classes such as lever pulling are employed.

Investigations by Penny (59), Ryan (63), and Watson and Ryan (88) have studied the effects of frustrative nonreward on lever pulling responses of kindergarten children. The apparatus, essentially the same in all these studies, consisted of two wooden boxes each containing a colored signal light (S1 and S2), a lever (R1 and R2), and a goal box (G1 and G2). S1, a red light, was the signal to pull R1. S2, a green light, was the signal to pull R2. A test trial consisted of subjects' seeing S1, pulling R1, and receiving on a fixed percentage of R1 responses a marble reward in G1, and then seeing S2, pulling R2 and receiving a marble in G2 following every R2 response. R2 lever pulling speeds were measured as a function of whether or not the R1 lever pull was rewarded or not rewarded.

Penny (59) found that nonreward of the R1 lever pull resulted in an increase in the speed of the R2 lever pulling response. His findings lent support to an earlier finding by Holton (37) that increase in the vigor of a response was a function of the number of prior continuous rewards before the introduction of nonreward. Ryan (63) divided 100 kindergarten children into two groups. One group (Group 100) received 100 percent rewards on both R1 and R2 responses while a second group (Group 50) received 50 percent rewards on R1 and 100 percent rewards on R2. The two groups were further differentiated with regard to a variable Ryan termed "incentive value." Half the subjects in each group were told they could trade accumulated marble rewards for their least preferred of six previously ranked toys; for the other half of the subjects the incentive employed was their first ranked toy. In all between-group comparisons, Group 50 was found to respond faster than Group 100 over successive blocks of R2 trials. No significant differences related to incentive value were found. Watson and Ryan (88) recently demonstrated that children gave faster lever pulling responses following nonreward on R1 but that this effect was only reliably shown when the R2 response followed the Rl response by five second intervals and not by ten or twenty second intervals. They concluded that nonreward did result in an increase of response vigor but that this effect was extremely transient and dissipated when the Rl-R2 interval was more than five seconds.

In another group of studies (14, 17, 18, 37, 64, 65, 66, 74) the activating properties of frustrative nonreward have been used to explain subjects' performances under conditions of partial reward. Subjects are asked to perform some response such as pulling a lever and are rewarded or not rewarded following each response. Lever pull speeds, for example, for subjects on various partial reward schedules are compared with lever pull speeds for continuously (100 percent) rewarded subjects over blocks of trials. A block of trials would consist, for example, in a 50 percent schedule, of four lever pulling responses, two of which were rewarded, two of which were not rewarded.

Bruning (14) investigated the acquisition and extinction of a lever movement response in children as a function of percentage of reward (50 versus 100 percent) and magnitude of reward (one versus five pieces of candy). He found that kindergarten children reinforced on a 50 percent schedule for lever pulling moved the lever faster during the acquisition condition than children reinforced 100 percent of the time. During extinction, both groups increased the speed of their lever movements for twelve trials. Magnitude of reward did not significantly affect lever movement speeds.

Investigations by Ryan and Cantor (65), Cantor and Ryan (17), and Ryan and Moffit (66) studied the effects of continuous and partial reward schedules on lever pulling speeds. These investigations all used as subjects kindergarten and preschool children and employed two groups of subjects, one of which received 50 percent rewards for lever pulling, the other of which received 100 percent rewards. The principle finding of these studies was that, after a number of blocks of trials, partially rewarded subjects were responding more vigorously (pulling the lever faster) than the continuously rewarded subjects.

Ryan (64) studied the effects of six reward schedules (100, 83, 66, 50, 33, and 17 percent) and age on speed of lever movement responses for 54 preschool and 54 kindergarten children. He found that the groups receiving 33, 50, or 66 percent rewards for lever pulling were responding significantly faster than the 100 percent group by the ninth and final block of trials. The groups receiving 17 and 83 percent rewards did not differ significantly from Group 100 in terms of lever movement speeds for the last block of trials.

In a recent study Ryan and Watson (67) explored the effects of the verbal reinforcers "Good," "Very Good," and "That's Fine" on the lever pulling speeds of kindergarten children. One group of subjects received 33 percent rewards for lever pulling while the other group received 100 percent rewards. Results confirmed those of previous investigations using marble reinforcers in that partially rewarded subjects developed faster lever starting and lever movement speeds over trial blocks than did continuously rewarded subjects.

Semler and Pederson (74) employed a within-subjects design to investigate the effect of reward schedule on lever pulling responses. In this study first grade children depressed a button, listened for a tone at the onset of a red or green warning light, and pulled a lever. For half the subjects, a marble reward was given on 100 percent of the trials initiated by the red warning light and on 50 percent of the trials initiated by the green warning light. Color conditions were reversed for the other half of the subjects. Results supported those of previous investigations using between-subject designs in that lever movement speeds were significantly faster for the partially rewarded condition.

It is apparent that under certain conditions, nonreward of a lever pulling response will result in subjects' increasing the speed of their lever pulls. This is reflected by (1) the faster R2 lever pulling speeds when R1 is not rewarded and (2) by the development of faster lever pulling speeds for partially rewarded subjects than continuously (100 percent) rewarded subjects over blocks of trials. These faster lever movement speeds during partial reward conditions have been interpreted in terms of a frustration hypothesis. That is, that when nonreward follows a response for which the organism has previously received reward, emotional reactions are elicited and these emotional reactions are reflected as increases in the vigor of the response.

In summary, all children tend to exhibit some disfluency in their speech. Children's disfluency rates are influenced to a greater or lesser degree by certain situational factors. Frustration is one factor frequently mentioned as being associated with disfluency augmentation; however, the relationship between frustration and speech fluency has not yet been studied experimentally. Recently, frustration has been conceptualized as the emotional responses which occur when nonreward follows a response previously rewarded. Nonreward for a speaking response previously rewarded might also be expected to elicit emotional responses in the speaker. If these emotional responses constitute what is known as "frustration" then these emotional responses should be accompanied by an increase in the rate of disfluency.

This present study attempts to determine if children will increase disfluency rates when changed from continuous to partial schedules of reward and from partial to continuous schedules of reward for speaking.

CHAPTER III

DESIGN OF THE INVESTIGATION

It was the purpose of this investigation to explore the effects of reward schedule changes on the speech fluency of normal-speaking seven-year-old males. The following research questions were formulated for this investigation:

1. Does the speech of young children become more disfluent when the schedule of reward for speech responses is changed from a continuous to a partial schedule of reward?

   A. Does the speech of young children become more disfluent when the schedule of reward for speech responses is changed from a partial to a continuous schedule of reward?

2. Is the change in disfluency in the speech of young children when the schedule of reward is changed from a continuous to a partial schedule a function of the ratio of rewards and nonrewards in the partial schedule?

3. Are young children more disfluent on speech responses following nonrewarded responses than on those responses following rewarded responses?

Subjects

Fifty white male children from Oklahoma City, Oklahoma, served as subjects in this study during the summer of 1968. The children ranged in age from six-years-nine-months to seven-years-ten-months with a mean age of seven-years-four months. The children came from areas of the city judged by the experimenter to be in the middle to upper-middle socioeconomic strata.

The following criteria were established for subject selection: (a) free from any speech or language problems as determined by the experimenter (articulation errors characteristic of children of the particular age levels were not considered as speech problems), (b) an I.Q. of at least ninety on the Peabody Picture Vocabulary Test (PPVT) (26), (c) no history of grade failure in school, and (d) no known vision or hearing problems.

Treatment Groups

Each child was shown thirty pictures, one at a time to each of which they responded with a story. These pictures were colored situational pictures depicting children and/or adults. Following each story the child was either rewarded or not rewarded according to a predetermined schedule. Five schedules of reward were used, a different schedule for each of five groups of ten subjects. Subjects were assigned randomly to the five groups. The groups are designated according to the type of reward schedule and percentage of stories followed by reward in each of two conditions. Reward schedules for Condition I and Condition II, group mean ages in months, and group mean PPVT I.Q. scores are shown in Table 1 for the five treatment groups.

Condition I was identical for Groups C-C, C-P75, C-P50, and C-P25. These subjects received continuous (100 percent) reward for responses to ten pictures in this condition. In Condition II these subjects responded to twenty pictures, but a different reward schedule was in effect for each treatment group. Group C-C continued to receive 100

TABLE 1

REWARD SCHEDULES FOR CONDITION I AND CONDITION II, MEAN AGE IN MONTHS, AND MEAN PEABODY PICTURE VOCABULARY TEST I.Q. SCORES FOR EACH OF FIVE TREATMENT GROUPS

Group	Condition I	Condition II
C-C		
Mean Age 87.6 PPVT I.Q. 106.7	Continuous Reward (100 percent)	Continuous Reward (100 percent)
C-P75		
Mean Age 89.4 PPVT I.Q. 115.8	Continuous Reward (100 percent)	Partial Reward (75 percent)
C-P50		
Mean Age 87.7 PPVT I.Q. 108.2	Continuous Reward (100 percent)	Partial Reward (50 percent)
C-P25		
Mean Age 89.9 PPVT I.Q. 108.4	Continuous Reward (100 percent)	Partial Reward (25 percent)
P50-C		
Mean Age 85.3 PPVT I.Q. 111.2	Partial Reward (50 percent)	Continuous Reward (100 percent)

percent rewards while Groups C-P75, C-P50, and C-P25 received 75 percent, 50 percent, and 25 percent rewards, respectively. Group P50-C, in Condition I, responded to twenty pictures and received 50 percent rewards. In Condition II this group responded to ten pictures and received 100 percent rewards.

Condition II represents no reward schedule change for Group C-C as they continue to receive a reward following each story. Subjects in Groups C-P75, C-P50, and C-P25 are switched from a continuous (Condition I) to a partial schedule of reward (Condition II). Subjects of Group P50-C are switched from a partial to a continuous schedule of reward. The reason for using Group P50-C was to determine if the differences in disfluency between continuous and partial schedule responses was a function of the direction of change between the two schedules.

For the partial reward schedules for Groups C-P75, C-P50, and C-P25 reward or nonreward was assigned randomly to the pictures with the following two restrictions: (1) nonreward always followed story number eleven and (2) reward always followed story number thirty. The reward schedule for Group P50-C in Condition I was identical to the Condition II reward schedule for Group C-P50. The rationale for the exceptions to randomnization was to have exactly 75, 50, or 25 percent of the responses follow reward and that the final response for each child be a rewarded response. Reward schedules were identical for all subjects within any one treatment group.

Materials and Apparatus

The experiment was conducted within two sound-treated rooms within the University of Oklahoma Medical Center Speech and Hearing Center.

The subject and the experimenter were located in one room, the experimental room, with an assistant in an adjacent control room. Between the two rooms was a two-way window and a talk-back system so that events in the experimental room could be monitored visually and auditorily by the assistant.

The subject and the experimenter sat at a small table facing a large multicolored clown face painted on a piece of four by eight foot plywood. A twelve-and-one-half watt red light bulb served as the clown's nose. Located in the center of the table and directly in front of the subject was an Electrovoice microphone, Model 664, which connected to an Ampex 601 magnetic tape recorder in the control room. A candy dispenser and a speaker through which certain verbal stimuli were delivered were located behind the clown figure and out of view of the subject. The speaker, Ampex model 620, was connected to a second Ampex 601 tape recorder in the control room which was used to deliver all verbal stimuli.

To the subject's front and left was a ten-inch plastic tube affixed by means of a metal clamp to the surface of the plywood forming the background of the clown. A red line was drawn around the circumference of the tube approximately midway along its length. Location of this line designated a previously measured point which would be reached by an accumulation of thirty M and M candies in the tube. Situated to the subject's front and right was a small package containing a toy glider wrapped in tissue paper.

Reward and Nonreward Events

When reward was designated to follow a story-telling response the subject heard the verbal stimulus, "That's good. Try again!" from the speaker located behind the clown figure, followed by the lighting of the red light that served as the clown's nose, and the dispensing of one candy reward into the plastic tube. When nonreward was designated to follow a picture the subject heard the verbal stimulus, "No. Try again!" from the speaker behind the clown.

All verbal stimuli were delivered by tape recorder and the same person (a male graduate student) was used in making the master tapes. To assure that all subjects heard the same two stimuli, a tape loop that contained the two stimuli was dubbed onto four continuous tapes following the reward schedules for the particular treatment groups.

Procedure

The experimenter met the subject and his parent or parents in the waiting room and spent a short time talking with them before taking the child to the experimental room. After entering the experimental room the experimenter spent approximately five minutes talking with the child about such topics as school, vacation plans, and pets in order to acclimate the child to the situation.

As soon as the child appeared to be at ease in the situation the experimenter read the following instructions:

> This is Happy the Clown. He would like you to tell him some stories about the pictures which I will show you soon. When you finish telling a story he will talk to you, his red nose will light up, and he will give you candy. The candy will fall into this tube. If you can fill the tube with candy to the red line, you will win the prize you see over here and get to keep the candy too. Do you understand?

When giving instructions the experimenter called the subject's attention to the tube, the red line, and the prize with hand gestures. When he felt the subject understood the instructions, the experimenter read the subject three example stories. The same three example stories were read to all subjects and subjects were allowed to view the stimulus pictures about which the experimenter read the stories.

After he had listened to the three example stories the subject was asked to tell two practice stories. The subject was informed that these stories were practice stories and would not be followed by reward. When subjects were reluctant to tell stories about the practice pictures they were prompted by the experimenter with questions and suggestions to stimulate verbalization. Following the telling of the two practice stories the subject was told:

> We are ready to start now. Let's go through the instructions one more time. Happy the Clown would like you to tell him stories about the pictures I show you. Remember, when you finish telling a story, Happy will talk to you and his red nose will light up. He will give you candy which will fall into this tube. If you fill the tube with candy to this red line, you will win the prize over here and get to keep the candy too. Are you ready?

When the child had indicated that he was ready to begin the experimenter presented the first picture and said, "Here's the first one," bringing the picture into view as he said the word "one." This first picture was an extra picture and not included in the experimental task or in the data analysis. This picture was always followed by reward so as to insure that the subject's first response in the experimental task would always follow a rewarded response. The thirty pictures of the experimental task were presented in a similar fashion with the experimenter always presenting the picture to the subject while saying the word "one."

A response was defined in this study as all of the subject's verbalizations between the word "one" and the termination of his story about a particular picture. All responses were recorded on an Ampex 601 magnetic tape recorder operated by the assistant in the control room. The tape recorder was activated when the subject began his practice stories and remained on throughout the session.

As the experimental task proceeded the experimenter commented on the color of the candy reward being dispensed once in every five responses. The reason for this was to keep the subject's attention on the accumulating candy. This procedure was not followed for subjects who commented about the color of the candy of their own volition.

Analysis of Disfluencies

Tape recordings of each subject's thirty story-telling responses were transcribed verbatim for disfluency analysis. After typewritten transcriptions for each subject had been completed, the experimenter again listened to each tape and made any necessary additional corrections in the transcriptions.

All judging of the tapes for instances and types of disfluency was done by the experimenter. No limit was set on the number of times a tape could be heard for judging. Each instance of disfluency was marked according to type on the transcript. Ten disfluency types were specified in this study. These included (1) vocal segregates, (2) revisions, (3) phrase repetitions, (4) word repetitions, (5) part-word repetitions, (6) other repetitions, (7) parenthetic remarks, (8) incoherent sounds, (9) broken words, and (10) prolongations. Each instance of disfluency, regardless of its number of units was counted as a single disfluency. A description of each disfluency type is given in Appendix A.

Disfluency types six through ten inclusively (other repetitions, parenthetic remarks, incoherent sounds, broken words, and prolongations) did not occur with sufficient frequency to warrant separate analysis. For the purposes of statistical analysis the ten disfluency types were organized into eight disfluency categories. These categories included (1) total disfluencies (disfluency types one through ten inclusively), (2) vocal segregates, (3) non-ah disfluencies (disfluency types two through ten inclusively), (4) total repetitions (disfluency types three through six inclusively), (5) phrase repetitions, (6) word repetitions, (7) part-word repetitions, and (8) revisions (grammatical and sentence corrections).

To check the reliability of his disfluency judgments the experimenter chose at random five tapes to be judged a second time. A minimum time period of two months elapsed between the first and second judgment sessions. The percentages of experimenter self-agreement between the first and second judgments for type of disfluency, instance of disfluency, and type and instance combined were computed using a formula previously employed by Sander (69). In this formula, Agreement Index = $a/(a + d)$, a = the number of agreements and d = the number of disagreements between the first and second judgment sessions. The percentages of experimenter agreements between the first and second judgment sessions were 97 percent for type of disfluency, 93 percent for instance of disfluency, and 91 percent for type and instance combined.

Interjudge reliability was also established using the same formula for percentage of agreement. Three tapes were chosen randomly from the fifty experimental tapes and disfluencies judged independently by a second judge. The three tapes were then listened to by the two judges jointly and a joint decision was made with respect to the instances and types of disfluencies. The following indices represent the percent of agreement between the experimenter and the joint decisions of the two judges. The index of agreement for type of disfluency was 97 percent, for instance, 94 percent, and for type and instance combined, 91 percent.

Word Counting

The number of words in each response was counted. All words were counted two times. In most cases the two counts were in agreement. If there was a discrepancy between the first and second counts for a response, further counts were made until agreement was attained or the experimenter was satisfied that an accurate count was obtained. Rules for word counting followed standards developed by McCarthy (52) and later extended by Davis (23) and Winitz (91), and presented by Johnson, Darley, and Spriestersbach (45).

Disfluency Measures

The measure of disfluency used in this study was the disfluency index developed by Johnson (43). The disfluency index represents the number of disfluencies (type or total) per 100 words spoken. Disfluency indices were computed for each subject in eight categories and formed the nucleus of raw data from which the subsequent statistical analyses were performed.

CHAPTER IV

RESULTS AND DISCUSSION

Results

This study explored the effects of changing from a continuous (100 percent) to partial (75, 50, or 25 percent) reward schedules and from partial (50 percent) to continuous reward schedules on children's speech fluency. Fifty children, five groups of ten subjects each, told stories about thirty situational pictures presented to them one at a time. Four treatment groups (C-C, C-P75, C-P50, and C-P25) told stories about ten pictures in Condition I (continuous schedule) and twenty pictures in Condition II (partial schedule). A fifth treatment group (Group P50-C) told stories about twenty pictures in Condition I (partial schedule) and ten pictures in Condition II (continuous schedule).

Verbal Output and General Level of Disfluency

The number of words obtained in a response to a single picture from any one subject varied from 4 to 307. The total number of words spoken by any one subject for all thirty pictures varied from 544 to 4140 words. The mean number of words per picture, range of subjects' means, and *t* values for differences between Condition I and Condition II means are presented in Table 2.

TABLE 2

MEAN NUMBER OF WORDS PER PICTURE AND RANGE OF SUBJECTS' MEANS FOR CONDITION I AND CONDITION II, AND *t* VALUES FOR DIFFERENCES BETWEEN CONDITION MEANS FOR FIVE GROUPS OF SUBJECTS

Group	Condition I Mean	Condition I Range of Means	Condition II Mean	Condition II Range of Means	*t* Value
C-C	36.16	21.70- 47.20	41.51	16.35- 53.00	2.72[a]
C-P75	53.30	14.30-107.20	67.54	21.90-119.50	3.12[b]
C-P50	35.72	22.20- 47.50	46.13	28.00- 70.75	4.41[c]
C-P25	35.38	17.00- 74.00	46.16	18.70-108.00	3.27[c]
P50-C	35.04	19.80- 55.80	40.56	19.90- 53.70	2.12

[a]Significant at the .05 level.

[b]Significant at the .02 level.

[c]Significant at the .01 level.

The three groups (C-P75, C-P50, and C-P25) switched from continuous reward in Condition I to partial reward in Condition II all show significant (< .02) increases in the mean number of words spoken per picture in Condition II as compared with Condition I. Subjects continuing to receive 100 percent rewards in Condition II (Group C-C) illustrate a significant (< .05) increase in the mean number of words uttered per picture in Condition II. Group P50-C subjects were changed from a partial schedule of reward in Condition I to a continuous schedule of reward in Condition II. These subjects exhibit a substantial, but statistically nonsignificant (> .05), increase in the mean number of words spoken per picture in Condition II.

Disfluency indices obtained in a response to a single picture from any one subject varied from 0.00 to 42.3 disfluencies per 100 words. Mean total disfluency indices and ranges of means for individual subjects in Condition I and Condition II are shown in Table 3.

There are no disfluency norms for male subjects the age of subjects in this study. The closest study with which the children of this investigation may be compared relative to overall disfluency is one by Johnson (42). In Johnson's study 68 male children ranging in age from two-and-one-half to eight years of age told stories about pictures from the Children's Aperception Test (CAT). The mean total disfluency index for these subjects was 7.28 compared to the mean total disfluency indices of 9.26 in Condition I and 9.09 in Condition II for subjects of this study. In addition to the fact that reward and nonreward followed subjects' story-responses in this investigation, other methodological differences between the two studies such as ages of subjects, method of

TABLE 3

MEAN DISFLUENCY INDICES (ALL TYPES OF DISFLUENCIES)
AND RANGES OF SUBJECTS' MEANS FOR
CONDITIONS I AND II

Group	Condition Mean	Condition I Range of Means	Condition II Mean	Condition II Range of Means
C-C	6.28	3.23-11.00	7.60	4.21-14.83
C-P75	10.82	4.90-20.60	10.46	5.94-17.54
C-P50	7.90	2.70-14.14	8.21	2.50-16.52
C-P25	12.10	5.42-19.08	12.70	7.34-18.40
P50-C	8.35	3.03-12.06	7.36	3.02-11.93

eliciting speech, recording techniques, definition of disfluency, and word counting procedures may have accounted for the differences in disfluency rates of the subjects.

Continuous and Partial Reward Schedule Effects

One question posed in this investigation was whether children would manifest changes in disfluency type and frequency when changed from a continuous (100 percent) to a partial (75, 50, or 25 percent) schedule of reward for speech responses. An extension of this question was whether children would manifest changes in disfluency type and frequency when changed from a partial (50 percent) to a continuous schedule of reward for speech responses.

Mean disfluency index differences between Condition I and Condition II were obtained by subtracting a subject's disfluency index in Condition I from his disfluency index in Condition II. Proportions of the mean total disfluency index contained in each category of disfluency were obtained for each treatment group. Mean disfluency indices for Condition I, Condition II, $\underline{t}$ values for differences between condition means, and the proportions of the mean total disfluency index for each disfluency category are presented in Tables 4 through 8. Certain disfluency types (other repetitions, parenthetic remarks, incoherent sounds, broken words, and prolongations) that did not occur with sufficient frequency to merit separate analyses are included in the mean total disfluency indices and the mean non-ah disfluency indices. Disfluencies designated as 'other repetitions' are included, also in the mean total repetition index.

Parenthetic remarks were the most frequently occurring disfluency type not separately analyzed in this study. Use of this disfluency

TABLE 4

MEAN DISFLUENCY INDICES FOR CONDITION I, CONDITION II, _t_ VALUES FOR DIFFERENCES BETWEEN CONDITION MEANS, AND PROPORTIONS OF TOTAL DISFLUENCIES FOR SUBJECTS IN GROUP C-C

Measure	Condition I Mean	Condition I Proportions	Condition II Mean	Condition II Proportions	_t_ Value
Total Disfluencies	6.28		7.60		1.43
Vocal Segregates	1.13	.180	1.43	.188	.57
Non-Ah Disfluencies	5.14	.818	6.17	.812	1.81
Total Reps.	1.58	.252	2.22	.292	1.80
Phrase Reps.	.28	.045	.47	.062	1.46
Word Reps.	.68	.108	.81	.106	.79
Part-Word Reps.	.54	.086	.85	.112	2.07
Revisions	2.78	.443	3.14	.413	1.28

TABLE 5

MEAN DISFLUENCY INDICES FOR CONDITION I, CONDITION II, *t* VALUES FOR DIFFERENCES BETWEEN CONDITION MEANS, AND PROPORTIONS OF TOTAL DISFLUENCIES FOR SUBJECTS IN GROUP C-P75

Measure	Condition I Mean	Condition I Proportions	Condition II Mean	Condition II Proportions	*t* Value
Total Disfluencies	10.82		10.46		- .58
Vocal Segregates	3.07	.284	2.33	.223	-2.42*
Non-Ah Disfluencies	7.74	.715	8.14	.778	.74
Total Reps.	3.31	.306	2.84	.272	-1.33
Phrase Reps.	1.02	.094	.84	.080	- .90
Word Reps.	1.43	.132	1.26	.120	- .63
Part-Word Reps.	.85	.079	.74	.071	- .67
Revisions	3.40	.314	4.39	.420	3.22*

*Significant at the .05 level of confidence.

TABLE 6

MEAN DISFLUENCY INDICES FOR CONDITION I, CONDITION II, _t_ VALUES FOR DIFFERENCES BETWEEN CONDITION MEANS, AND PROPORTIONS OF TOTAL DISFLUENCIES FOR SUBJECTS IN GROUP C-P50

Measure	Condition I Mean	Condition I Proportions	Condition II Mean	Condition II Proportions	_t_ Value
Total Disfluencies	7.90		8.21		.67
Vocal Segregates	2.36	.299	1.88	.229	-1.85
Non-Ah Disfluencies	5.54	.701	6.30	.767	1.60
Total Reps.	1.41	.178	1.83	.223	2.10
Phrase Reps.	.44	.056	.39	.048	- .80
Word Reps.	.59	.076	.96	.117	2.46*
Part-Word Reps.	.36	.046	.46	.056	.67
Revisions	3.07	.389	3.44	.419	1.00

*Significant at the .05 level of confidence.

TABLE 7

MEAN DISFLUENCY INDICES FOR CONDITION I, CONDITION II, *t* VALUES FOR DIFFERENCES BETWEEN CONDITION MEANS, AND PROPORTIONS OF TOTAL DISFLUENCIES FOR SUBJECTS IN GROUP C-P25

Measure	Condition I Mean	Condition I Proportions	Condition II Mean	Condition II Proportions	*t* Value
Total Disfluencies	12.10		12.70		.67
Vocal Segregates	4.58	.378	3.94	.310	-1.78
Non-Ah Disfluencies	7.49	.619	8.75	.689	1.91
Total Reps.	2.55	.211	3.07	.242	1.40
Phrase Reps.	.51	.042	.86	.068	1.46
Word Reps.	1.47	.121	1.34	.106	- .46
Part-Word Reps.	.57	.047	.84	.066	1.45
Revisions	3.89	.321	4.42	.348	1.89

TABLE 8

MEAN DISFLUENCY INDICES FOR CONDITION I, CONDITION II, *t* VALUES FOR DIFFERENCES BETWEEN CONDITION MEANS, AND PROPORTIONS OF TOTAL DISFLUENCIES FOR SUBJECTS IN GROUP P50-C

Measure	Condition I Mean	Condition I Proportions	Condition II Mean	Condition II Proportions	*t* Value
Total Disfluencies	8.35		7.36		-1.26
Vocal Segregates	1.56	.187	1.05	.143	-1.96
Non-Ah Disfluencies	6.76	.810	6.31	.857	- .74
Total Reps.	2.90	.347	2.77	.376	- .44
Phrase Reps.	.90	.108	.74	.100	- .50
Word Reps.	1.32	.158	1.38	.188	.23
Part-Word Reps.	.62	.074	.65	.088	.20
Revisions	2.93	.351	3.14	.427	.57

type appeared to be an individual speaker characteristic as some children tended to begin each of their stories with a parenthetic remark such as "Well," or "Oh let's see."

Group C-C showed mean disfluency index increases in all eight disfluency categories from Condition I to Condition II. Many of these increases appear quite substantial although none were statistically significant (< .05). Increases in proportions in four and decreases in three disfluency categories are evident. The largest increase in proportions for the group occurred for the total repetition category, due primarily to increases in the proportions of phrase and part-word repetitions. Although Group C-C showed an absolute increase in revisions, they illustrated a decrease in proportions for this type of disfluency in Condition II compared with Condition I.

Group C-P75 illustrated a slight and nonsignificant decrease in their mean total disfluency index for Condition II compared to Condition I. With the exception of the revision and the non-ah disfluency categories, these subjects exhibit lower mean disfluency indices for all disfluency categories in Condition II. Group C-P75 had a significant (< .05) increase in revisions and a significant (< .05) decrease in vocal segregates. The group shows a very large increase in proportions for revisions which serves also to increase the proportion of non-ah disfluencies since revisions are included in this category. A large decrease in proportions for vocal segregates coincides with the similarly large absolute mean decrease for vocal segregates.

Subjects in Group C-P50 increased their mean total disfluency index, although not significantly, when switched to partial reward in

Condition II. These subjects manifested mean disfluency index increases in all disfluency categories except for phrase repetitions and vocal segregates. The mean disfluency index increase was significant for word repetitions ($< .05$) and relatively large increases were evidenced for non-ah disfluencies and total repetitions. The mean vocal segregate decrease for this group was also large. The largest increase in proportions for the group is seen in the non-ah speech disfluency category reflecting increases for repetitions and revisions which are included in the non-ah speech disfluency index. Group C-P50 shows a substantial decrease in proportions for vocal segregates.

The mean total disfluency index for Group C-P25 subjects was slightly, although not significantly, larger in Condition II than in Condition I. These subjects illustrated substantially higher mean disfluency indices, though none were significant, for all disfluency categories except word repetitions and vocal segregates. Group C-P25 shows large increases in proportions for revisions and total repetitions. The increases in these two categories contribute to the large increase in proportions for the non-ah disfluency category.

Group P50-C subjects substantially decreases, although also not significantly, their mean total disfluency index for Contion II relative to Condition I. Mean disfluency index values in Condition II for these subjects were smaller than Condition I values in all disfluency categories except word repetitions, part-word repetitions, and revisions. Increases and decreases in proportions for Group P50-C did not coincide closely with mean disfluency index changes. While these subjects show absolute mean disfluency index decreases in five of eight disfluency categories, the only substantial decrease in proportions for Condition II is in the vocal segregate category. The small absolute increase in the mean revision index is associated with a large proportional increase. This revision increase is reflected in a similarly large proportional increase for non-ah disfluencies even though the group mean disfluency index for non-ah disfluencies decreased.

Between Group Comparisons

A second question asked in this investigation was whether the disfluency changes shown by children after being switched from a continuous (100 percent) to a partial (75, 50, or 25 percent) schedule of reward would be related to the ratio of rewards to nonrewards in the partial schedule.

Due to the apparently large differences among the mean total disfluency indices for Condition I for the four treatment groups, C-C, C-P75, C-P50, and C-P25, an analysis of covariance was used to test the differences between the Condition II means for each of the eight categories of disfluency. This analysis is used to adjust the Condition II means for differences in the Condition I means and also allows for testing the differences between the Condition I means. Group P50-C was not included in this analysis because partial and continuous reward conditions were reversed for this group relative to the other four treatment groups.

Significant $\underline{F}$ values for differences among the Condition I means were obtained for total disfluencies ($< .01$), total repetitions ($< .01$), phrase repetitions ($< .01$), and word repetitions ($< .05$). Nonsignificant $\underline{F}$ values were obtained for part-word repetitions, revisions, vocal segregates and non-ah disfluencies. Since four of the eight disfluency categories evidenced significant differences between the groups during Condition I, adjustment of the Condition II means seems particularily appropriate.

A summary of the analysis of covariance is shown in Table 9. The F value for the revision category was significant (< .01) indicating the presence of group differences in the adjusted Condition II mean revision indices. None of the F values calculated to test the differences between the adjusted Condition II means for the remaining seven disfluency categories were significant (< .05). Thus, when differences in Condition I disfluency measures are considered, the four groups of subjects differ significantly for Condition II only in revision type disfluencies.

Duncan's New Multiple Range Tests (84) were performed to test the difference between each of the possible pairs of adjusted group means in Condition II. Groups C-P75 and C-P25 had significantly larger (< .05) mean revision indices than either Groups C-C or C-P50. In addition, significant differences were obtained for two other disfluency categories. Group C-P25 had a significantly larger (< .05) mean total disfluency index than either Group C-C or Group C-P50 and a significantly larger (< .05) mean vocal segregate index than any of the other three groups in Condition II.

Nonreward-Reward Comparisons

A third question asked in this investigation was whether children receiving partial reward for speaking would exhibit higher speech disfluency rates for responses that followed nonreward than for responses that followed reward.

TABLE 9

SUMMARY OF ANALYSIS OF COVARIANCE TESTING FOR DIFFERENCES BETWEEN THE ADJUSTED CONDITION II MEAN DISFLUENCY INDICES FOR EIGHT DISFLUENCY CATEGORIES FOR GROUPS C-C, C-P75, C-P50, AND C-P25

	Source	Sums of Squares X	Sums of Squares Y	Sums of Products XY	Sums of Squares Residual	df	ms	F
Total Disfl.	Adj. Trt.				10.14	3	3.38	.61
	Error	400.12	486.90	370.98	142.96	26	5.50	
	Total	612.42	646.41	549.65	153.10	29		
Vocal Segs.	Adj. Trt.				1.48	3	.49	.73
	Error	205.19	152.75	166.60	17.40	26	.67	
	Total	246.97	180.74	199.94	18.88	29		
Non-Ah	Adj. Trt.				3.95	3	1.32	.42
	Error	189.91	233.59	169.25	82.75	26	3.18	
	Total	242.96	284.17	219.04	86.70	29		
Total Reps.	Adj. Trt.				2.99	3	1.00	1.35
	Error	44.10	50.59	37.24	19.14	26	.74	
	Total	68.32	58.39	49.77	22.13	29		

TABLE 9--Continued

	Source	Sums of Squares X	Sums of Squares Y	Sums of Products XY	Sums of Squares Residual	df	ms	*F*
Phrase Reps.	Adj. Trt.				.95	3	.32	1.23
	Error	7.04	7.38	2.55	6.46	26	.26	
	Total	9.58	9.19	4.13	7.41	29		
Word Reps.	Adj. Trt.				.24	3	.08	.16
	Error	12.23	15.22	5.34	12.89	26	.50	
	Total	18.89	17.11	8.67	13.13	29		
Part-Word	Adj. Trt.				.28	3	.09	1.50
	Error	8.22	6.37	3.74	1.70	26	.06	
	Total	9.36	7.37	4.30	1.98	29		
Revisions	Adj. Trt.				14.61	3	4.87	34.78*
	Error	40.00	47.24	59.54	3.75	26	.14	
	Total	46.76	43.45	58.73	18.36	29		

*Significant at the .01 level.

Mean disfluency index differences for responses following nonreward and reward were obtained by subtracting subjects' disfluency indices for responses following reward (R) from their indices for responses following nonreward (NR). These comparisons involved pictures eleven to thirty, Condition II, for Groups C-P75, C-P50, and C-P25 and pictures one to twenty, Condition I, for Group P50-C. These comparisons will henceforth be referred to as mean NR-R differences.

Since the order of pictures was the same for the subjects in all five groups, it was possible to analyze the data for Group C-C four times, each time applying the schedule of reward used for one of the partially rewarded groups. The reward schedule for Group C-P50, for example, when applied to the responses from Group C-C, yielded a separate mean disfluency index for Group C-C for those pictures which followed reward for Group C-P50 and for those which followed nonreward for Group C-P50. Thus a comparable mean NR-R difference could be obtained from the responses of Group C-C, for the same pictures which followed reward and nonreward in each of the other four groups.

Mean disfluency indices for responses following nonreward and reward, mean differences, and t values for differences between means are shown in Tables 10 through 13 for the four partially rewarded treatment groups and for the comparable measures for Group C-C.

Group C-P75 subjects were more disfluent in responses following nonreward than reward in all disfluency categories except phrase repetitions. None of the differences were significant, however. Mean NR-R values for Group C-C were smaller than those for Group C-P75 in six of eight cases, and were in no instance significant.

TABLE 10

MEAN DISFLUENCY INDICES FOR PICTURES FOLLOWING NONREWARD (NR) AND REWARD (R), MEAN DIFFERENCES, AND *t* VALUES FOR DIFFERENCES BETWEEN MEANS FOR SUBJECTS IN GROUPS C-P75 AND C-C

Group	Total Disfl.	Vocal Segs.	Non-Ah Disfl.	Total Reps.	Phrase Reps.	Word Reps.	Part-Word Reps.	Revisions
C-P75								
NR Mean	11.07	2.55	8.52	3.06	.82	1.47	.78	4.74
R Mean	10.23	2.25	7.99	2.75	.85	1.17	.71	4.22
Diff.	.84	.30	.53	.31	-.03	.30	.07	.52
t Value	.76	.62	.56	1.00	-.15	2.14	.30	.80
C-C								
NR Mean	7.69	1.39	6.31	2.24	.45	.78	.98	3.15
R Mean	7.53	1.46	6.08	2.22	.48	.82	.82	3.06
Diff.	.16	- .07	.23	.02	-.03	- .04	.16	.09
t Value	.24	- .36	.37	.07	-.12	- .29	.73	.18

TABLE 11

MEAN DISFLUENCY INDICES FOR RESPONSES FOLLOWING NONREWARD (NR) AND REWARD (R), MEAN DIFFERENCES, AND _t_ VALUES FOR DIFFERENCES BETWEEN MEANS FOR SUBJECTS IN GROUPS C-P50 AND C-C

Group	Total Disfl.	Vocal Segs.	Non-Ah Disfl.	Total Reps.	Phrase Reps.	Word Reps.	Part-Word Reps.	Revisions
C-P50								
NR Mean	8.56	2.12	6.44	1.97	.45	.94	.56	3.05
R Mean	8.17	1.95	6.22	1.75	.35	1.00	.41	3.70
Diff.	.39	.17	.22	.22	.10	- .06	.15	- .65
_t_ Value	.50	.40	.40	.51	.62	- .31	.83	-2.60*
C-C								
NR Mean	7.45	1.54	5.91	2.23	.47	.87	.87	2.91
R Mean	7.75	1.34	6.36	2.13	.50	.75	.80	3.40
Diff.	- .30	.20	- .45	.10	-.03	.12	.07	- .49
_t_ Value	- .38	.80	-2.93*	.15	-.12	.67	.18	-1.06

*Significant at the .05 level of confidence.

TABLE 12

MEAN DISFLUENCY INDICES FOR RESPONSES FOLLOWING NONREWARD (NR) AND REWARD (R), MEAN DIFFERENCES, AND *t* VALUES FOR DIFFERENCES BETWEEN MEANS FOR SUBJECTS IN GROUPS C-P25 AND C-C

Group	Total Disfl.	Vocal Segs.	Non-Ah Disfl.	Total Reps.	Phrase Reps.	Word Reps.	Part-Word Reps.	Revisions
C-P25								
NR Mean	13.03	4.04	8.98	3.33	.89	1.48	.94	4.14
R Mean	11.47	3.63	7.81	2.22	.75	.95	.52	4.55
Diff.	1.56	.41	1.17	1.11	.14	.53	.42	- .41
t Value	1.79	.77	2.17	4.48[b]	.70	2.26[a]	1.54	-1.20
C-C								
NR Mean	7.67	1.43	6.24	2.24	.53	.77	.72	3.25
R Mean	7.29	1.52	5.77	2.17	.27	.74	1.17	2.78
Diff.	.38	- .09	.47	.06	.26	.03	- .45	.47
t Value	.54	- .17	.52	.16	1.62	.16	-1.57	1.12

[a]Significant at the .05 level of confidence.

[b]Significant at the .01 level of confidence.

TABLE 13

MEAN DISFLUENCY INDICES FOR RESPONSES FOLLOWING NONREWARD (NR) AND REWARD (R), MEAN DIFFERENCES, AND *t* VALUES FOR DIFFERENCES BETWEEN MEANS FOR SUBJECTS IN GROUPS P50-C AND C-C

Group	Total Disfl.	Vocal Segs.	Non-Ah Disfl.	Total Reps.	Phrase Reps.	Word Reps.	Part-Word Reps.	Revisions
P50-C								
NR Mean	8.36	1.56	6.80	2.63	.88	1.05	.62	3.22
R Mean	8.50	1.54	6.92	3.19	.98	1.67	.63	3.25
Diff.	- .14	.02	- .12	- .56	-.10	- .62	-.01	- .03
t Value	- .17	.08	- .39	-1.20	-.39	-1.77	-.02	- .05
C-C								
NR Mean	7.06	1.30	5.77	1.96	.46	.60	.85	2.91
R Mean	6.88	1.29	5.52	1.76	.31	.76	.61	3.03
Diff.	.18	.01	.25	.20	.15	- .16	.24	- .12
t Value	.33	.04	.30	.67	.68	- .70	.89	- .65

Positive mean NR-R differences were obtained for Group C-P50 in six of eight disfluency categories. These values, however, were small and in all cases nonsignificant. These subjects emitted significantly more revisions ($< .05$) per 100 words on pictures that followed reward than on pictures that followed nonreward. Most mean NR-R differences for Group C-C were also small and nonsignificant. The negative mean NR-R value for non-ah disfluencies for Group C-C was significant ($< .05$).

Children in Group C-P25 were more disfluent on responses to pictures following nonreward than pictures following reward. The mean NR-R difference for total disfluencies was large and positive mean NR-R differences were evident for seven of eight disfluency categories. Mean NR-R differences were significant for total repetitions ($< .01$) and for word repetitions ($< .05$). Positive mean NR-R values were also evidenced for Group C-C in six of eight disfluency categories but differences were small and in all cases nonsignificant. The two groups show opposing trends in the part-word repetition and revision categories. Group C-P25 has a higher mean part-word repetition index on responses that follow nonreward than responses that follow reward and a higher mean revision index on responses that follow reward than responses that follow nonreward. Group C-C for the same responses that for Group C-P25 follow nonreward shows a lower mean part-word repetition index and a higher mean revision index than for the responses that for Group C-P25 follow reward.

Group P50-C subjects were slightly more disfluent, but nonsignificantly, on responses following reward than on responses following nonreward. Negative mean NR-R values were evidenced for these subjects in seven of eight disfluency categories. For the corresponding pictures, Group C-C showed small positive mean NR-R differences in six of eight disfluency categories none of which were significant.

Discussion

If nonreward for speaking responses previously rewarded results in frustration, and children respond to frustration by being more disfluent in speech, then it might have been expected that groups switched from a continuous reward schedule in Condition I to a partial reward schedule in Condition II would have been more disfluent in the partial reward condition. This, however, was not found to be the case in this investigation. While there were increases in the mean total disfluency indices for Groups C-P50 and C-P25, these increases were small and statistically nonsignificant. The greatest increase, although also nonsignificant, in the mean total disfluency index occurred for Group C-C, while Group C-P75 showed a slight decrease in their mean total disfluency index in Condition II as compared with Condition I. Group P50-C subjects also showed a decrease in their mean total disfluency index for Condition II.

Significant results may not have been obtained in this study because of the limited operational view of frustration as the emotional responses elicited when nonreward follows a response previously rewarded. Although several studies (14, 59, 63, 74, 88) have found increases in the "vigor" of certain instrumental responses (for example, lever pulling) following frustrative nonreward, nonreward of this type may not affect speech fluency measures. Most children are accustomed to an intermittent schedule of reward for speech (75) and it is possible that changing from a continuous to a partial schedule of reward for speech will not elicit emotional reactions which will be reflected in disfluency increases.

Children may be more disfluent when the frustration is operationally defined as a constant blocking of the children from some highly desirable goal. Perhaps, also, the effects of nonreward for speaking when reward is anticipated are reflected in nonspeech behaviors or in parameters of speech other than fluency.

The possibility exists that the emotional reactions evoked in children when nonreward follows speaking responses previously rewarded would be reflected in disfluency increases, but that certain variables influence the degree to which this frustrative nonreward affects speech fluency. A number of these variables may have been responsible for the failure in obtaining significant disfluency increases in this study for subjects switched from continuous reward in Condition I to partial reward in Condition II.

All groups showed significant or large increases in the mean number of words spoken per picture in Condition II as compared with Condition I. It is possible that by giving longer responses in Condition II subjects may have reduced their disfluency rates for that condition. Cook (20) has stated that long utterances reflect that the speaker is "getting into stride" and is talking easily about a familiar topic. In a disfluency analysis of the interviews of eleven college students, he found that non-ah disfluencies were more prevalent in utterances of thirty to fifty words in length than in utterances of less than thirty or more than fifty words. If length of utterance is related to disfluency rate this would have a greater influence on those groups switched from continuous to partial schedules of reward (C-P75, C-P50, and C-P25) since these subjects manifested greater increases in the mean number of words spoken per picture than did the continuously rewarded subjects of Group C-C or subjects switched from partial to continuous reward (Group P50-C).

There is little information relative to the effects of continuous (100 percent) reward on speech fluency. It is unreasonable, therefore, to regard group performances in Condition I as basal fluency measures. The results of this investigation are somewhat suggestive that continuous reward might even cause subjects to increase disfluency. Group C-C received 100 percent rewards in Conditions I and II. Although there was no reward schedule change for this group, they substantially increased their mean total disfluency index in Condition II as compared to Condition I. Groups C-P75, C-P50, and C-P25 received 100 percent rewards in Condition I. An analysis of the responses within Condition I revealed that Groups C-P50 and C-P25 substantially increased their total disfluency rates from the first five to the second five responses of the condition. Groups C-P75 and C-C showed slight decreases in their mean total disfluency indices on the second five responses of Condition I. It appears that one reason for Groups C-P50 and C-P25, at least, not showing higher disfluency indices in Condition II than Condition I is that they were already increasing their disfluency rates before they were switched from a continuous to a partial reward schedule.

There are certain aspects of the experimental design for this study which may have influenced the results in such a way as to lessen the probability of obtaining the predicted changes. The rewards (the M and M's) for example, were accumulated in a clear plastic tube such that the children could see the rewards but could neither touch them nor eat them until the candy reached the red line on the tube. The children therefore could see the presumably desirable candy but were blocked from obtaining it immediately. Blocking a child from a desirable goal is of course, one operational procedure for creating a frustrating state of affairs (5, 19, 41, 56). The children in this study, therefore, may have been frustrated by this procedure as well as by the nonreward of previously rewarded responses. Seeing the candy rewards accumulate in the tube may also have resulted in the children anticipating the eating of the candy. Some of the physiological and emotional responses aroused in the subject by seeing the candy and anticipating its eating may disrupt speech fluency. Reactions such as these may not be unlike those which Hull (38, 39) and Spence (81, 82) have designated as fractional goal responses.

The effects of fatigue and boredom on speech fluency cannot be discounted in this investigation. The speaking task of story-telling is demanding of the child in terms of time and difficulty. Experimental sessions ordinarily lasted from twenty-five to forty minutes with the child verbalizing most of this time. Completion of the experimental task (telling thirty stories) necessitated also that the child stay seated in his chair and remain in the experimental room. Individual children may react to being confined and limited in movement and to fatigue by being more disfluent in their speech.

It was not always possible to determine immediately if a child had ended his story or was just pausing. Therefore the time elapsing between the end of a subject's story and the dispensing of a reward was not constant. Thus, certain subjects may have faced delay in waiting for the candy to be dropped into the collection tube which may have resulted in frustration even when responses were rewarded. The possible frustration resulting from blocking the child from the candy, from confinement in the room, and from the delay in presenting rewards could explain, at least in part, the increase of disfluency from Condition I to Condition II for Group C-C, C-P50, and C-P25 and within Condition I for Groups C-P50 and C-P25.

Some children evidenced concern that time would run out before they could tell enough stories to fill the tube and win the prize. These subjects asked the experimenter how many pictures were left or attempted to see how many pictures were remaining. Others, on the other hand, appeared relatively unconcerned as to how many pictures there were in the task. Subjects concerned with time, even though they may be continuously rewarded, might be more disfluent than subjects not concerned with time. Subjects not concerned with time elapsing may show little change in disfluency because they feel they will be given enough trials to eventually fill the tube with candy.

The rewards used in this study (candy and 'That's good. Try again!') may not have been sufficiently motivating for all subjects so that their absence would result in frustration reactions. M and M's have, however, been demonstrated to be among the more desirable rewards for children (86). Children were not deprived of candy for controlled periods of time prior to participating in the present study. Also certain children may have a higher preference for M and M candy than others and therefore have been more disfluent than subjects caring little about M and M candy.

Results could also have been affected if situational pictures do not have the same stimulus value for all children. A child who tells a story about a picture of a situation similar to one he has recently experienced might be less disfluent on that picture than a child for whom the situation has little meaning. Certain pictures may remind children of "unpleasant" or "happy" experiences and result in their being more or less disfluent on those pictures. Apart from individual subjects' reactions to certain pictures, some pictures may tend to bring about emotional reactions in the children as a group more than other pictures. This variable was not controlled when pictures were randomly assigned to Conditions I and II or to reward or nonreward.

The time period between reward or nonreward events and the beginning of the story-telling responses following these events was another uncontrolled variable. There is reason to believe that the emotional reactions elicited by nonreward when reward is expected rapidly dissipate with time. Watson and Ryan (88) in a study of reward effects on kindergarten children's lever pulling responses, found that the frustration effect (faster lever pulling speeds following nonrewarded trials than rewarded trials) could only be reliably demonstrated when the lever pulling responses followed the nonreward by five seconds. When speeds of lever pulling responses following nonreward by ten and twenty seconds were measured, the frustration effect was not demonstrable. Subjects in the present study frequently looked silently at the picture before beginning their story, asked questions of the experimenter, or made irrelevant comments either before or after presentation of the picture. Comments, questions, and pausing by subjects increased the time period between the nonreward event and the beginning of the story-response following. With this time increase, emotional reactions induced by nonreward which might be evidenced as disfluency increases could dissipate and subjects might show little disfluency change.

The verbal stimulus "No. Try again!" may be regarded as a mild form of punishment instead of simply a nonreward for a speaking response. Nonreward itself may even be viewed as punishment in that positive reinforcement is withheld from the subject. The stimulus "No. Try again!" was used to let the child know that the response was considered finished and also to signal nonreward of the speech response. It was felt that the child, in the absence of such a signal, might emit some behavior that would interfere with the experimental task of story-telling, such as, getting out of his chair to look behind the clown figure. Particular preference of the word "no" rested on the fact that this word had been shown to be least effective as a verbal punisher with respect to other verbal and nonverbal stimuli (13).

The results of this investigation are somewhat similar to those studies dealing with the effects of random punishment on speech fluency and suggest that "No. Try again!" possibly served as a random aversive stimulus. Three of four groups (C-P50, C-P75, and P50-C) illustrated higher, although nonsignificant, mean total disfluency indices under conditions of partial reward than conditions of continuous reward. These results are consistent with investigations that show subjects to become slightly more disfluent under conditions of random punishment (11, 36, 70, 83). One might view random nonreward for a speaking response as essentially the same as random punishment of a response.

Individual children vary in terms of frustration tolerance (87) as well as the manner in which they respond to frustrating situations (25, 92, 93). Tests of frustration such as the Rosenzweig Picture Frustration Test (61) are based on the fact that individuals respond differently to frustration. It is reasonable to expect that nonreward for speaking responses that have previously been rewarded will affect the speech fluency of some children more than others. It may be more profitable, therefore, to study the effects of frustrative nonreward with individual subjects rather than groups of individuals.

Two subjects in this study responded such that their individual disfluency indices markedly affected the mean disfluency indices of their particular groups. The performance of a single subject in Group C-C greatly affected the mean total disfluency index for his group. On listening to the tape recording for this child the experimenter noted that the child frequently commented on how difficult the pictures were and that he did not feel capable of telling stories about the pictures. This child more than doubled his total disfluency index (7.36 to 14.83) in Condition II compared with Condition I and thus elevated the group mean total disfluency index considerably.

Another subject in Group C-P25 markedly influenced the group mean total disfluency index for his group. This subject, during Condition I was distractable, jovial, generally uncooperative and highly disfluent. Upon hearing the first "No. Try again!" from the clown, he became quiet, attentive and increasingly fluent and acted as if the clown had said "no" specifically to punish his behavior. When the total disfluency indices for these two subjects are not included in the mean total disfluency indices for their particular groups, the results for Groups

C-C and C-P25 are in agreement with the earlier prediction that subjects changed from continuous to partial reward would show increases in disfluency and subjects continuing to receive 100 percent rewards would show little disfluency change.

Individuals may also employ different approaches to the experimental task of story telling. Subjects were instructed only to "tell stories" about the pictures presented to them. Some subjects named the items and described the actions in the pictures while others employed more elaborate explanations or stories. Levin, Silverman and Ford (50) found children to be significantly more disfluent when the speaking task involved explanation rather than description. Conceivably disfluency rates of subjects in this study could be affected by the type of response, that is, description or explanation.

Individual differences in the interpretation of nonreward may also influence speech fluency. Indications of these differences were reflected in the comments of subjects after completion of the task. When asked what they thought had happened when the clown said "No. Try again!" most subjects responded in one of two ways. Some stated that they felt they had not told a "good enough" story while others simply stated that they did not know the reason for the clown saying "No. Try again!" Reactions to frustration are reported to be more vigorous when the imposed frustrating event is arbitrary rather than nonarbitrary (15, 16, 57). Children who feel that nonreward signals that they have not told a good story may view the event as nonarbitrary and justifiable. Their reaction may be to try to "tell a better story" and they may show little change in total disfluency. Children who see no reason for the nonreward and view the event as an arbitrary, unjustifiable punishment may respond emotionally and with more disfluency when speaking.

Subjects' responses to frustrative nonreward conditions may be influenced by age. It has been shown that older children tend to exhibit more rationalizing and problem-solving type responses in frustrating situations (25, 93). The children of this study were slightly older than those subjects employed in the instrumental studies demonstrating increases in vigor of responding following nonreward events. Conceivably, seven-year-old children encounter nonreward situations with some degree of regularity. Thus, children in this investigation may have accepted frustrative nonreward for speaking as a "natural consequence" and simply rationalized any reactions evoked by the nonrewards.

Although the predicted changes in total disfluency from Condition I to Condition II were not obtained, or at least were not statistically significant, the four groups that were switched to a different schedule of reward for speaking in Condition II exhibit a trend with respect to the emission of certain disfluency types not seen in the performances of subjects in Group C-C. From Condition I to Condition II Groups C-P75, C-P50, C-P25, and P50-C illustrate substantial absolute and proportional decreases in their mean vocal segregate indices and greatly increase their proportions for non-ah disfluencies. Subjects (Group C-C) continuing to receive 100 percent rewards in Condition II show slight and moderate absolute increases for vocal segregates and non-ah disfluencies respectively, but small proportional changes in both of these disfluency categories. One reason for the proportional increase in non-ah disfluencies for Groups C-P75, C-P50, C-P25 and P50-C was that these groups illustrated consistent absolute and proportional increases in revisions. Group C-C subjects, while showing an absolute increase in revisions for Condition II shows a proportional decrease for this type disfluency.

It has been found (53) that pauses, filled (vocal segregates) and unfilled (silent pauses), tend to occur most often in the speech sequence at points of high uncertainty in either semantic (lexical) or grammatic (structural) choice. Relative preference for filled or unfilled pauses seems to be an aspect of individual style of speaking (33, 49, 53). Maclay and Osgood (53) suggest that the distinction between filled and unfilled pauses lies mainly in the duration of the nonspeech interval. These authors as well as others (49, 75) feel that the speaker is motivated to keep control of the conservation "until he has achieved a measure of completion." But a speaker learns that it is during silent pauses that he is most likely to lose the conversational "ball." Therefore, the longer the pause, the more likely the speaker is to produce a vocal segregate in order to inform the listener he is still in control. Thus, the frequency of filled pauses is hypothesized to depend on the length of the nonspeech interval and the degree of a speaker's silence tolerance.

Levin and Silverman (49) have stated that grammatical and sentence corrections ('revisions' in this study) represent efforts by subjects to "try and do a better job." Many of the children in this study commented in the post-task conversation that they interpreted "No. Try again!" as indicating that the clown did not like their story and that they tried to tell a better one.

Condition II decreases in vocal segregates for Groups C-P75, C-P50, and C-P25 suggest that one of the effects of frustrative nonreward may be to reduce the amount of time speakers spend in silent and filled pauses (vocal segregates) at points of uncertainty in the speech sequence. If speakers spend less time silently deciding what they are going to say, they would not feel the need to insert a vocal segregate into the non-speech interval to signal that they are not yet finished speaking. In addition, if less time is spent in decision making at points of high uncertainty, then the likelihood of revision once the person begins to speak is increased. Revision increases for subjects changing reward schedules in Condition II support the speculation that frustrative non-reward may decrease a speaker's decision time.

If the reduction in vocal segregates and increase in revisions is an effect of frustrative nonreward then the question arises as to why similar changes in vocal segregate and revision indices occurred for Group P50-C from Condition I to Condition II. It may be that the subjects in this group, when confronted with nonrewards in Condition I, also tried to "improve" their stories by reducing pause time. The continuous rewards of Condition II might have served to reward this behavior and to cause an increase in it. If this is true, then it would appear that the changes in vocal segregates and revisions observed in Condition II for Groups C-P75, C-P50, and C-P25 might be the effect of the nonrewards in the partial schedule itself rather than the effect of switching from continuous to partial rewards. On the other hand, ten continuous rewards may not be necessary to establish frustrative nonreward. The instructions to the children regarding rewards, the initial rewarded response, plus the 50 percent rewards in Condition I may have been sufficient to establish "frustrative nonreward" for the subjects in Group P50-C.

The expectancy that Condition II disfluency increases for partially rewarded subjects (Groups C-P75, C-P50, and C-P25) would be correlated with the ratio of rewards to nonrewards in the partial schedule was not supported by the data. The fact that the adjusted mean total disfluency, revision, and vocal segregate indices for Group C-P25 were significantly different than those for Groups C-C and C-P50 is somewhat suggestive that subjects changed from a continuous to a partial schedule of reward for speaking are more likely to increase disfluency significantly when the schedule of reward contains a small ratio of rewards to nonrewards.

While most of the differences were small and nonsignificant there appears to be a tendency for subjects in Groups C-P75, C-P50, and C-P25 to have higher disfluency indices for responses following nonreward than for those following reward in Condition II. This tendency is seen most clearly in Group C-P25 for which significant mean NR-R differences were obtained in two categories and large but nonsignificant differences were evidenced in several other disfluency categories. The one noticeable exception to this tendency is in the category of revisions. Group C-P50 had significantly more revisions and Group C-P25 had substantially, though not significantly, more revisions following rewarded responses than following nonrewarded responses. Although there were some exceptions, comparable mean NR-R differences for Group C-C were generally smaller than those for the partially rewarded groups.

Group C-P25 subjects emitted significantly more total repetitions following nonreward than reward. This difference in total repetitions was due primarily to substantial differences in part-word repetitions and in word repetitions. In addition, revisions constituted a much smaller proportion of the total disfluencies following nonreward than following reward for this group. Group C-P50 emitted more repetitions and significantly fewer revisions while Group C-P75 showed more repetitions and also more revisions following nonreward than reward. Part-word repetitions, and word repetitions, to a lesser extent (9, 89), are among the disfluencies most likely to be labeled stuttering. Revisions, on the other hand, are more likely to be considered 'normal' disfluencies (42). There appears, therefore, to be a tendency as the ratio of rewards to nonrewards decreases for the responses following nonreward to contain a higher proportion of those disfluencies considered stuttering-type disfluencies and a smaller proportion of those considered 'normal' disfluencies.

Unlike the groups which were switched from a continuous to a partial schedule, Group P50-C had higher disfluency indices in seven of eight categories for responses following reward than for those following nonreward. All differences were nonsignificant, however. It would appear, though, that the direction of the switch between continuous and partial schedules may have a differential effect on the subjects' rates of various types of disfluencies following rewarded and nonrewarded responses.

CHAPTER V

SUMMARY

The purpose of this experiment was to examine the effects of changes between continuous and partial schedules of reward for speaking on the speech disfluency rates of normal speaking children. Fifty seven-year-old male children, five groups of ten children each, told stories about each of thirty situational pictures. Four treatment groups told stories about ten pictures in Condition I and twenty pictures in Condition II. One of these groups (Group C-C) received 100 percent (continuous) rewards in both conditions. The other three groups received 100 percent rewards in Condition I and rewards for 75 percent (Group C-P75), 50 percent (Group C-P50), and 25 percent (Group C-P25) of their responses in Condition II. A fifth treatment group (Group P50-C) told stories about twenty pictures in Condition I and ten pictures in Condition II, with 50 percent of these responses in Condition I and 100 percent of the responses in Condition II rewarded. In each condition reward or nonreward was not contingent upon a specific behavior but followed each response according to a prearranged schedule. Reward schedules were different for all five groups, but were identical for all subjects within a particular group.

Sound recordings of all the responses from each child were made and the responses were later transcribed verbatim. The transcriptions and recordings were used in the analysis of disfluencies in the responses. Tabulations of ten types of disfluency were made for each response. These ten types of disfluency were (1) vocal segregates, (2) revisions, (3) phrase repetitions, (4) word repetitions, (5) part-word repetitions, (6) other repetitions, (7) parenthetic remarks, (8) incoherent sounds, (9) broken words, and (10) prolongations. The latter five types occurred so infrequently for many subjects that separate statistical analyses were performed for the first five categories plus three new categories: total disfluencies (combining all ten types), non-ah disfluencies (all types except vocal segregates), and total repetitions (combining the categories of phrase, word, part-word, and other repetitions). Rate of disfluency was expressed in terms of the number of disfluencies in the specific category per 100 words spoken.

The main findings of this study were:

1. All five experimental groups showed substantial increases in mean number of words spoken per response in Condition II as compared to Condition I.

2. Three groups (Groups C-C, C-P50, and C-P25) increased and two groups (Groups C-P75 and P50-C) decreased their mean total disfluency indices from Condition I to Condition II, but all changes were nonsignificant.

3. Four groups (C-P75, C-P50, C-P25, and P50-C) had substantially lower proportions of vocal segregates and higher proportions of revisions in Condition II than in Condition I. Group C-C showed a slightly higher proportion of vocal segregates and lower proportion of revisions

in Condition II than in Condition I.

4. Mean disfluency indices for most categories of disfluency for Condition II, when adjusted for differences in Condition I for Groups C-C, C-P75, C-P50, and C-P25, did not seem to be related to the ratio of rewards to nonrewards in Condition II with the exceptions that Groups C-P75 and C-P25 had significantly larger mean revision indices than Groups C-C or C-P50, and Group C-P25 had a significantly larger mean total disfluency index than either Group C-C or Group C-P50 and a significantly larger mean vocal segregate index than any of the other three groups.

5. Groups C-P75, C-P50, and C-P25 tended to have higher disfluency indices for those responses following nonreward than for those following reward in Condition II for all categories of disfluency except revisions for which Groups C-P50 and C-P25 had substantially more following rewarded responses than following nonrewarded responses. Group P50-C had more disfluencies following reward than nonreward in Condition I for seven of the eight disfluency categories, but all differences were very small.

The results of this study are generally inconclusive due, in part, to several uncontrolled experimental variables. The results, however, do suggest that changes in schedules of reward do have an effect on the rate of disfluencies of various types in the speech of young children. Further study of these effects would seem merited.

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APPENDIX A

Description of Disfluency Types

Description of Disfluency Types

1. Vocal Segregates. Vocal segregates are pause fillers in speech such as /um/, /er/, /uh/, /ah/, and /mm/. Laughs, chuckles and throat clearing sounds are not classified as vocal segregates nor as disfluencies.

2. Revisions. Revisions may include whole phrases, words or parts of words and phrases and in general represent an attempt by the speaker to change or to correct what he has said. Some examples of revision type disfluencies are as follows:

(a) He was, she was going to town.
(b) The fa, the mother was home.
(c) Here, there it is.
(d) The father wi, may come back.
(e) She baked a take, cake.

3. Phrase Repetitions. Phrase repetitions involve the repetition of two or more words but may also include an incomplete word, and may be separated by a vocal segregate, incoherent sound, or parenthetic remark, in which case two instances of disfluency are counted. Some examples of phrase repetitions are as follows:

(a) The fort is, the fort is on fire.
(b) His fa, his father is rich.
(c) The boy, um, the boy is riding his bike.

4. Word Repetitions. Word repetitions include all repetitions of whole words. Word repetitions may also be separated by a vocal segregate, incoherent sound or parenthetic remark in which case two disfluencies are counted. Some examples of word repetitions are as follows:

(a) She, she will be home soon.
(b) It, it's too big for me right now.
(c) Bill, um Bill wants to play ball with us.

5. Part-Word Repetitions. Part-word repetitions include all

repetitions of less than a whole word with no distinction being made between sound and syllable repetitions. Part-word repetitions may be separated by a vocal segregate, incoherent sound, or parenthetic remark in which case two disfluencies are tabulated. Some examples of part-word repetitions are as follows:

(a) I'll re, repeat the number.
(b) He wants a sack of po, um, potatoes.

6. Other Repetitions. Other repetitions is a category reserved for identical repetition of a word or phrase and a vocal segregate. In such cases two disfluencies, one vocal segregate and one phrase or word repetition, are counted. Some examples of other repetitions are as follows:

(a) A boy um, a boy um, will go swimming.
(b) Go um, go um home now please.

7. Parenthetic Remarks. Parenthetic remarks include words and phrases which the speaker appears to be using to stall for time to think of what he's going to say. Some examples of parenthetical remarks are as follows:

(a) Well, a boat can sail on water.
(b) There's a, oh let's see, girl standing there.
(c) A man had, oh what do you call that, a basket in his hand.

8. Incoherent Sound. Incoherent sounds include those audible vocal noises not identifiable as words or as any other disfluency type.

9. Broken Words. Broken words include those words with marked separations in their pronunciation.

10. Prolongations. Prolongations include words and sounds judged to be unduly prolonged in their utterance.

APPENDIX B

Disfluency Indices for Ten Subjects in Each of Five Treatment Groups
for Conditions I and II, and for Responses Following
Nonreward (NR) and Reward (R) for Groups
C-P75, C-P50, C-P25 and P50-C

TABLE 14

TOTAL DISFLUENCY INDICES FOR TEN SUBJECTS IN EACH OF FIVE TREATMENT GROUPS FOR CONDITIONS I AND II, AND FOR RESPONSES FOLLOWING NONREWARD (NR) AND REWARD (R) FOR GROUPS C-P75, C-P50, C-P25, AND P50-C

	Subjects									
	1	2	3	4	5	6	7	8	9	10
Group C-C										
I	5.13	9.24	5.15	7.36	11.00	4.59	6.78	3.83	6.46	3.23
II	4.79	13.02	5.72	14.83	8.92	4.61	8.55	5.25	4.21	6.12
Group C-P75										
I	7.39	4.90	7.95	9.87	8.62	15.87	8.37	20.60	16.95	7.65
II	5.94	6.16	8.49	11.31	9.25	14.33	6.84	15.86	17.54	8.83
NR	5.59	4.24	10.53	7.14	10.04	16.76	11.15	17.70	16.78	10.74
R	6.09	6.88	7.71	13.16	8.92	13.27	5.20	15.12	17.79	8.19
Group C-P50										
I	2.70	9.68	5.46	4.33	5.29	13.93	14.14	7.06	8.57	7.82
II	2.50	11.02	5.99	6.40	6.67	12.06	16.52	6.82	7.98	6.82
NR	1.84	11.96	5.60	7.44	6.22	13.82	18.64	6.70	5.97	7.40
R	3.12	10.24	6.29	5.46	7.06	10.84	14.74	6.90	10.61	6.43
Group C-P25										
I	7.42	5.42	12.07	15.57	17.30	7.03	16.47	14.45	19.08	6.17
II	9.66	5.35	16.36	15.60	11.25	8.77	18.40	16.81	17.41	7.34
NR	10.05	5.78	17.22	16.17	12.29	9.82	18.07	17.43	16.76	6.67
R	8.30	3.75	14.22	13.42	7.53	5.18	19.15	14.39	19.84	8.88
Group P50-C										
I	3.03	8.90	12.06	5.67	5.29	11.91	10.98	4.22	10.64	10.81
II	5.66	10.90	11.93	4.51	5.54	5.61	9.71	3.02	8.17	8.57
NR	2.27	9.38	9.68	5.53	5.58	12.44	12.61	4.87	10.38	10.89
R	3.64	8.47	15.69	5.76	5.04	11.48	9.71	3.57	10.92	10.68

TABLE 15

VOCAL SEGREGATE INDICES FOR TEN SUBJECTS IN EACH OF FIVE TREATMENT GROUPS FOR CONDITIONS I AND II, AND FOR RESPONSES FOLLOWING NONREWARD (NR) AND REWARD (R) FOR GROUPS C-P75, C-P50, C-P25, AND P50-C

	Subjects									
	1	2	3	4	5	6	7	8	9	10
	Group C-C									
I	.26	2.10	0.00	3.56	.78	.00	1.91	0.00	2.72	0.00
II	.12	1.90	.16	8.04	.54	.31	2.60	.18	.48	0.00
	Group C-P75									
I	1.40	2.64	0.00	2.65	4.72	1.12	4.32	3.50	4.48	5.91
II	1.82	.64	.23	2.69	4.70	.21	4.29	1.78	3.17	3.73
NR	2.85	1.05	.85	2.26	2.38	.14	4.76	1.91	4.87	4.43
R	1.42	.46	0.00	2.86	5.73	.24	4.09	.80	2.49	3.50
	Group C-P50									
I	0.00	1.68	.36	.36	1.47	4.72	6.57	2.59	3.71	2.16
II	0.00	1.06	1.20	.22	1.64	3.30	5.12	2.75	3.94	.55
NR	0.00	1.40	2.00	.23	1.49	4.84	5.30	2.51	2.65	.82
R	0.00	.78	.60	.21	1.77	2.23	4.97	2.93	5.63	.37
	Group C-P25									
I	1.48	0.00	3.45	5.10	8.80	.92	7.65	4.18	12.56	1.61
II	1.66	0.00	3.53	2.78	6.68	.82	7.67	4.68	10.27	1.35
NR	1.54	0.00	3.85	3.09	7.35	1.06	7.63	4.95	9.59	1.32
R	2.08	0.00	2.75	1.57	4.30	0.00	7.80	3.60	12.81	1.40
	Group P50-C									
I	0.00	.15	4.86	.33	.27	5.34	2.27	.44	1.60	.33
II	.38	.24	3.29	0.00	.19	3.12	1.35	0.00	1.39	.56
NR	0.00	0.00	4.52	0.00	.19	6.45	2.01	.44	1.64	.36
R	0.00	.28	5.39	.50	.34	4.44	2.48	.45	1.56	.27

TABLE 16

NON-AH DISFLUENCY INDICES FOR TEN SUBJECTS IN EACH OF FIVE TREATMENT GROUPS FOR CONDITIONS I AND II, AND FOR RESPONSES FOLLOWING NONREWARD (NR) AND REWARD (R) FOR GROUPS C-P75, C-P50, C-P25, AND P50-C

	Subjects									
	1	2	3	4	5	6	7	8	9	10
					Group C-C					
I	4.87	7.14	5.15	3.80	10.21	4.59	4.87	3.83	3.74	3.22
II	4.67	11.13	5.56	6.79	8.38	4.30	5.95	5.07	3.72	6.12
					Group C-P75					
I	4.75	4.90	5.30	5.15	7.50	11.55	4.86	16.12	11.04	6.25
II	5.30	5.94	5.80	6.16	9.04	10.04	5.17	12.69	13.81	7.01
NR	4.54	3.39	8.27	4.76	9.90	11.99	9.24	12.83	12.35	7.89
R	5.63	6.88	4.86	7.43	8.68	9.18	3.63	12.63	14.30	6.71
					Group C-P50					
I	2.70	8.00	5.09	3.97	3.82	9.21	7.58	4.47	4.86	5.66
II	2.50	9.96	4.79	6.18	5.03	8.77	11.40	4.07	4.04	6.27
NR	1.84	10.56	3.60	7.21	4.73	8.99	13.35	4.19	3.32	6.58
R	3.12	9.47	5.69	5.25	5.30	8.61	9.77	3.97	4.98	6.07
					Group C-P25					
I	5.93	5.52	8.62	10.47	8.49	5.76	8.83	10.27	6.52	4.56
II	8.00	5.35	12.83	12.82	4.57	7.95	10.64	12.13	7.14	5.99
NR	8.51	5.78	13.37	13.08	4.95	8.76	10.44	12.48	7.17	5.29
R	5.98	3.75	11.47	11.85	3.22	5.18	11.35	10.79	7.02	7.48
					Group P50-C					
I	3.03	8.75	7.19	5.33	5.02	6.57	8.71	3.77	9.03	10.48
II	5.28	10.66	8.64	4.51	5.35	2.49	8.35	3.02	6.77	8.01
NR	2.27	9.38	5.16	5.53	5.38	5.99	10.60	4.42	8.74	10.53
R	3.64	8.19	10.29	5.19	4.70	7.04	7.22	3.12	9.36	10.41

TABLE 17

TOTAL REPETITION INDICES FOR TEN SUBJECTS IN EACH OF FIVE TREATMENT GROUPS FOR CONDITIONS I AND II, AND FOR RESPONSES FOLLOWING NONREWARD (NR) AND REWARD (R) FOR GROUPS C-P75, C-P50, C-P25, AND P50-C

	Subjects									
	1	2	3	4	5	6	7	8	9	10
Group C-C										
I	1.03	3.78	1.10	1.42	2.36	1.89	1.48	.43	1.36	.92
II	.72	6.57	2.29	3.16	2.72	.84	1.36	.74	1.44	2.45
Group C-P75										
I	1.58	3.50	2.65	2.58	3.47	5.60	.58	7.46	3.73	1.96
II	1.80	2.06	1.86	1.62	3.30	3.81	1.05	5.58	5.54	1.76
NR	2.10	1.70	2.26	.95	4.45	5.14	1.91	4.87	5.83	1.42
R	1.67	2.19	1.71	1.91	2.84	3.24	.80	5.87	5.44	1.80
Group C-P50										
I	.45	2.53	.73	1.44	1.18	2.25	2.02	.47	.86	2.16
II	.54	3.18	1.88	.99	1.17	3.39	2.90	.84	1.69	1.76
NR	0.00	4.19	1.60	.93	.25	3.46	4.45	1.40	1.49	1.92
R	1.04	2.34	2.10	1.05	1.99	3.35	1.60	.42	1.95	1.65
Group C-P25										
I	2.33	1.81	2.76	3.76	2.52	1.84	2.94	3.42	1.45	2.68
II	3.31	1.34	5.37	3.80	.94	2.81	4.07	4.39	2.61	2.10
NR	3.66	1.36	5.68	3.74	1.20	3.32	4.42	4.77	2.76	2.42
R	2.08	1.25	4.59	4.03	0.00	1.04	2.84	2.88	2.07	1.40
Group P50-C										
I	1.52	4.30	2.72	1.33	2.51	2.88	4.04	.67	2.64	6.44
II	2.26	4.03	4.53	1.59	3.17	.93	3.16	1.00	2.19	4.84
NR	.57	4.06	1.61	.79	2.69	2.30	5.73	.88	1.46	6.17
R	2.27	4.52	4.41	1.15	2.35	3.33	2.71	.45	3.90	6.85

TABLE 18

PHRASE REPETITION INDICES FOR TEN SUBJECTS IN EACH OF FIVE TREATMENT GROUPS FOR CONDITIONS I AND II, AND FOR RESPONSES FOLLOWING NONREWARD (NR) AND REWARD (R) FOR GROUPS C-P75, C-P50, C-P25, AND P50-C

	Subjects									
	1	2	3	4	5	6	7	8	9	10
					Group C-C					
I	.26	.84	0.00	0.00	0.00	1.08	.21	0.00	.40	0.00
II	.24	1.22	.16	.29	.87	.42	.25	.28	.96	0.00
					Group C-P75					
I	0.00	.70	1.52	1.29	1.46	1.17	.19	2.09	.62	1.12
II	.42	0.00	.21	.44	1.67	1.13	.28	2.28	1.40	.55
NR	0.00	0.00	0.00	0.00	2.30	1.76	.64	1.77	1.17	.52
R	.61	0.00	.29	.64	1.42	.85	.13	2.49	1.48	.56
					Group C-P50					
I	0.00	.84	.36	.36	.29	.44	.76	.24	.28	.81
II	0.00	.85	.34	.44	.12	.85	.68	0.00	.19	.44
NR	0.00	1.24	0.00	.46	.25	.69	1.27	0.00	0.00	.55
R	0.00	.52	.60	.42	0.00	.96	1.78	0.00	.43	.37
					Group C-P25					
I	.64	0.00	.69	.27	.63	.31	0.00	1.52	.24	.80
II	1.52	.27	1.96	.97	.12	.47	1.25	.54	1.13	.45
NR	1.77	.34	1.64	.99	.15	.60	1.20	.55	1.21	.44
R	.42	0.00	2.75	.90	0.00	0.00	1.42	.72	.83	.47
					Group P50-C					
I	.76	1.93	.97	.17	.54	.41	1.64	.22	.47	1.86
II	.38	.71	1.23	0.00	.79	.62	.90	.50	.40	1.86
NR	0.00	2.19	.97	.40	.38	0.00	2.29	.44	.18	2.00
R	1.36	1.70	.98	0.00	.67	.74	1.13	0.00	.78	1.64

TABLE 19

WORD REPETITION INDICES FOR TEN SUBJECTS IN EACH OF FIVE TREATMENT GROUPS FOR CONDITIONS I AND II, AND FOR RESPONSES FOLLOWING NONREWARD (NR) AND REWARD (R) FOR GROUPS C-P75, C-P50, C-P25, AND P50-C

	Subjects									
	1	2	3	4	5	6	7	8	9	10
					Group C-C					
I	.77	1.26	.37	.71	1.04	.81	.85	.21	.34	.46
II	.24	2.44	1.31	1.15	.44	.31	.62	.28	.36	.92
					Group C-P75					
I	1.06	1.40	0.00	.86	1.34	2.22	.39	3.88	2.64	.47
II	.74	.23	1.04	.73	1.13	1.61	.66	2.16	3.56	.72
NR	1.05	.85	.75	.48	1.58	1.94	.96	2.21	4.20	.65
R	.61	0.00	1.14	.85	.94	1.47	.53	2.14	3.34	.71
					Group C-P50					
I	0.00	1.05	0.00	.36	.88	1.57	1.26	.24	.28	.27
II	.18	1.77	1.20	.22	.70	2.17	1.16	.36	1.22	.66
NR	0.00	2.17	1.20	.23	0.00	2.54	1.48	.28	1.00	.55
R	.35	1.43	1.20	.21	1.32	1.91	.89	.42	1.52	.74
					Group C-P25					
I	1.27	.60	1.72	2.55	.97	1.22	2.94	1.14	.72	1.61
II	1.38	.54	2.62	1.16	.59	1.40	1.41	2.34	.96	1.05
NR	1.54	.34	3.11	1.28	.75	1.66	1.41	2.39	.99	1.32
R	.83	1.25	1.38	.67	0.00	.52	1.42	2.16	.83	.47
					Group P50-C					
I	.50	1.48	.97	.50	1.44	1.85	1.77	0.00	.85	3.82
II	1.13	2.61	1.65	.53	1.58	.31	1.58	.50	1.20	2.79
NR	.57	.94	0.00	.40	1.73	.92	2.29	0.00	.55	3.08
R	.45	1.98	2.45	.58	1.18	2.59	1.35	0.00	1.17	4.93

TABLE 20

PART-WORD REPETITION INDICES FOR TEN SUBJECTS IN EACH OF FIVE TREATMENT GROUPS FOR CONDITIONS I AND II, AND FOR RESPONSES FOLLOWING NONREWARD (NR) AND REWARD (R) FOR GROUPS C-P75, C-P50, C-P25, AND P50-C

	Subjects									
	1	2	3	4	5	6	7	8	9	10
					Group C-C					
I	0.00	1.68	.74	.24	1.31	0.00	.42	.21	.34	.46
II	.24	2.85	.82	.77	1.41	.10	.50	.18	.12	1.53
					Group C-P75					
I	.53	1.40	1.14	.43	.45	2.22	0.00	1.49	.47	.37
II	.64	1.83	.62	.44	.50	.97	.18	1.14	.58	.49
NR	1.05	.85	1.50	.48	.57	1.41	.32	.88	.47	.26
R	.46	2.19	.29	.42	.47	.77	.12	1.25	.62	.54
					Group C-P50					
I	.45	.21	.36	.72	0.00	.22	0.00	0.00	.28	1.33
II	.36	.56	.34	.33	.35	.19	1.06	.48	.28	.66
NR	0.00	.78	.40	.23	0.00	.23	1.70	1.12	.50	.82
R	.69	.39	.30	.42	.66	.16	.53	0.00	0.00	.55
					Group C-P25					
I	.42	1.20	.34	.94	.97	.31	0.00	.76	.48	.27
II	.46	.54	.78	1.67	.23	.94	1.41	1.46	.35	.60
NR	.36	.68	.92	1.46	.30	1.06	1.81	1.84	.33	.66
R	.83	0.00	.46	2.46	0.00	.52	0.00	0.00	.41	.47
					Group P50-C					
I	.25	.89	.78	.67	.54	.20	.38	.44	1.32	.76
II	.76	.71	1.44	1.06	.79	.31	.68	0.00	.60	.19
NR	0.00	.94	.64	.79	.58	.46	.57	.44	.73	1.09
R	.45	.85	.98	.58	.50	0.00	.23	.45	1.95	.27

TABLE 21

REVISION INDICES FOR TEN SUBJECTS IN EACH OF FIVE TREATMENT GROUPS FOR CONDITIONS I AND II, AND FOR RESPONSES FOLLOWING NONREWARD (NR) AND REWARD (R) FOR GROUPS C-P75, C-P50, C-P25, AND P50-C

	Subjects									
	1	2	3	4	5	6	7	8	9	10
					Group C-C					
I	3.08	3.36	2.57	1.66	4.71	2.70	3.39	2.34	1.70	2.33
II	3.47	3.26	2.94	2.68	3.05	3.25	3.72	3.69	1.68	3.67
					Group C-P75					
I	2.11	1.40	1.89	2.58	3.58	4.90	4.08	3.88	5.91	3.64
II	3.29	3.20	3.52	4.84	5.36	5.52	3.10	3.81	6.88	4.40
NR	2.45	2.54	5.26	3.81	5.31	6.17	5.73	5.75	5.13	5.30
R	3.65	3.44	2.86	5.31	5.38	5.17	1.81	3.02	7.46	4.10
					Group C-P50					
I	2.25	3.79	2.91	2.53	2.65	4.04	4.80	1.88	3.14	2.78
II	1.43	5.72	2.91	2.76	3.39	3.11	7.15	2.03	2.25	3.63
NR	1.47	5.27	1.60	2.55	3.73	2.99	6.99	.83	1.82	3.28
R	1.38	6.09	3.29	2.94	3.09	3.34	7.28	2.92	2.81	3.86
					Group C-P25					
I	3.39	3.61	4.83	6.58	3.46	3.36	5.29	2.66	4.11	1.61
II	4.42	4.74	6.54	7.22	2.70	3.27	5.48	3.95	3.57	3.29
NR	4.49	2.04	6.77	7.29	2.54	3.32	5.22	4.03	3.30	2.42
R	4.14	2.50	5.96	6.93	3.22	3.10	6.38	3.59	4.54	5.14
					Group P50-C					
I	1.89	3.86	3.11	2.65	1.98	2.87	4.74	1.00	4.38	2.79
II	1.52	5.45	2.88	3.33	1.88	1.25	3.41	2.89	5.46	3.28
NR	1.70	5.31	2.25	1.97	1.73	4.14	2.86	3.53	6.01	2.72
R	1.36	2.54	5.39	4.32	2.01	1.85	3.83	2.23	4.87	4.10