70-23,964

BOYSEN, Allen Edward, 1939-
THE EFFECTS OF NONREWARD ON THE OBJECT-NAMING LATENCIES AND RESPONSE DURATIONS OF NORMAL-SPEAKING AND STUTTERING CHILDREN.

The University of Oklahoma, Ph.D., 1970
Speech Pathology

University Microfilms, A XEROX Company, Ann Arbor, Michigan

THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

THE EFFECTS OF NONREWARD ON THE OBJECT-NAMING LATENCIES AND RESPONSE DURATIONS OF NORMAL-SPEAKING AND STUTTERING CHILDREN

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

ALLEN EDWARD BOYSEN

Oklahoma City, Oklahoma

1970

THE EFFECTS OF NONREWARD ON THE OBJECT-NAMING LATENCIES

AND RESPONSE DURATIONS OF NORMAL-SPEAKING

AND STUTTERING CHILDREN

APPROVED BY

Walter L. Cullinan

Donald Counihan

Floyd W. Emanuel

Glenda J. Edwards

Roy B. Deal Jr

DISSERTATION COMMITTEE

ACKNOWLEDGMENTS

The writer expresses his most sincere appreciation to Dr. Walter L. Cullinan, director of this study, for his constant encouragement and guidance during the course of this research as well as for his efforts in the planning and completion of this project. Appreciation is also expressed to the members of the dissertation committee, Dr. Donald T. Counihan, Dr. Floyd W. Emanuel, Dr. Roy B. Deal, Jr., and Dr. Glenda J. Ochsner for their helpful assistance and suggestions during the various stages of this study.

Additional acknowledgment is made to Dr. Roy B. Deal, Jr., and Dr. Donald E. Parker of the Department of Biostatistics and Epidemiology, University of Oklahoma Medical Center, for their assistance and advice concerning the statistical analysis of the data, to Dr. Floyd W. Emanuel for his advice concerning instrumentation and measurement procedures, and to the children and their parents who participated in this study.

The writer is particularly grateful to his wife, Deanna, for her constant encouragement, understanding, and moral support throughout this period of graduate study.

TABLE OF CONTENTS

TABLE OF CONTENTS--Continued

LIST OF TABLES

LIST OF ILLUSTRATIONS

THE EFFECTS OF NONREWARD ON THE OBJECT-NAMING LATENCIES AND RESPONSE DURATIONS OF NORMAL-SPEAKING AND STUTTERING CHILDREN

CHAPTER I

INTRODUCTION

The application of principles of learning has greatly facilitated investigation and modification of speech disfluency in adults during the past few years. Various schedules of reinforcement and punishment, for example, have been demonstrated to have predictable effects on the rate of fluency in both adult normal speakers and adult stutterers.

It has been speculated (56) that excessive disfluency and stuttering have their origins in complex reinforcement and punishment schedules in childhood. The possibility that stuttering is maintained by situations in which both reinforcement and punishment appear have been suggested often in clinical reports as well. While an attempt has been made to obtain normative data on speech fluency in young children, classifying type and amount of disfluency according to various speaking activities (14, 15), little has been done to study the effect of reward and/or punishment on the fluency of children.

There have been many investigations of the effects of varying reward schedules on nonspeech behaviors of children (51). The results of these studies often have been interpreted in terms of a frustration hypothesis, with frustration being conceptualized as an emotional response which occurs in an organism when nonreward follows a previously rewarded response (1, 64).

The adverse effects of frustration on speech fluency, while frequently mentioned in the literature (32, 69), have not been demonstrated experimentally. Upon studying the effects of frustrative nonreward on rate of disfluencies in the connected speech of young male children, Marshall (34) did not find significant differences in overall disfluency rate. Because of certain procedural differences required to obtain connected speech samples, however, his investigation was not directly comparable to the studies of frustrative nonreward effects on nonspeech behaviors. He did note, however, a tendency as the ratio of rewards to nonrewards decreased for the responses following nonreward to contain a higher proportion of those types of disfluencies more frequently called stuttering and a smaller proportion of those usually considered normal disfluencies. His results also suggested that one of the effects of frustrative nonreward might be a reduction in the amount of time speakers spend in silent and filled pauses at points of uncertainty in the speech sequence. These results suggest that further study of the effect of frustrative nonreward on the speech of children is merited.

It was the purpose of the present investigation to study the effects of frustrative nonreward on the speech of young children using a speaking task which approaches the simplicity of the nonspeech tasks used in other studies (51). The task chosen for study involved the single-word naming of a pictured object. The effects of frustrative nonreward on (a) object-naming latency (time elapsing between stimulus onset and response onset) and (b) response duration (time elapsing from onset of response to termination of response) were measured. It was also the purpose of this investigation to compare the behavior of normal-speaking children on this task with that of stuttering children. In view of the comments in the literature concerning adverse effects of frustration on speech fluency, it might be expected that frustrative nonreward would have a greater effect on stuttering children than on normal-speaking children.

CHAPTER II

REVIEW OF THE LITERATURE

Reinforcement and Punishment of Speech Disfluencies

In recent years, considerable interest has centered around learning models in the explanation of and the manipulation of overt stuttering behaviors. Stuttering behaviors have been related to learning concepts in many ways, such as, comparing stuttering adaptation to experimental extinction (76). Using frames of reference based on learning theories, stuttering has been viewed, for example, as an instrumental avoidance behavior (77), an approach-avoidance conflict (58), operant behavior (19, 56), and as conditioned disintegration of speech (11).

When the presentation of aversive stimuli such as electric shock (13, 18, 35, 61), verbal punishment (7, 36, 42, 62, 63), time-out from speaking (27), and noise (8, 9) have been made contingent on the occurrence of disfluency, adult normal speakers and adult stutterers have decreased their disfluency rate. When aversive stimuli have been presented randomly during speaking or reading tasks, adult normal speakers (8, 9, 52, 61) and adult stutterers (70) have increased disfluency. Hill (28) found that when electric shock was paired with a light during oral reading, subsequent presentation of the light alone (threat of shock) resulted in greater speech "disorganization" (speech disturbances) than in a control condition consisting of the light alone prior to the introduction of shock. Stassi (66) presented the verbal stimuli "Right" and "Wrong" randomly following normal-speaking subjects' production of nonsense words. Reading various words under four reward schedules, subjects were rated as being significantly more disfluent on reward schedules containing a greater percentage of punishments ("Wrong"). It is difficult to compare the relative effects of the various aversive stimuli on disfluency because of the methodological differences in the investigations. However, it is clear that disfluencies generally decreased under conditions of response-contingent punishment, while an increase in disfluencies was noted with random punishment.

The effect of nonreward on the stuttering response has also been investigated. Sheehan (57) contended that even though stuttering is punishing, it persists because of its continual reinforcement. The assumption is made that the point at which the stutterer completes a word is the point of reinforcement, and that stuttering is the instrumental act receiving reinforcement. He hypothesized that stuttering should decrease most rapidly with a decrease in the amount of reinforcement of the stuttering response and an increase in the reinforcement of the normal speech attempt. Twenty adult stutterers were presented with successive readings of a 200-word passage and acted as their own controls. In the control condition the subjects read in their characteristic way, while the experimental (non-reinforcement) condition required them to repeat each stuttered word until it was spoken once without stuttering before going on to the next word. It was found that, compared with the control condition, frequency of stuttering decreased more rapidly through successive readings in the non-reinforcement condition.

Davis (14, 15) attempted to obtain normative data on speech fluency in young children. She used as subjects sixty-two children ranging in age from twenty-four to sixty-two months. Everything said by a child during two one-half hour preschool free-play periods was noted by an observer using a speed writing technique. Another observer recorded as much as possible of all that was said to the child, as well as the activity of the child and his companions. Although Davis had hoped to determine whether or not each instance of repetition was accompanied by some recognizable factor(s) in the environment or situation, the plan was abandoned because of the difficulty in discovering such factors. She felt, however, that certain situational factors could be recognized in relation to instances when repetitions of the same syllable, word or phrase were uttered three or more times. From her rank ordering of these situations according to frequency of occurrence, it appears that many of the high ranking situations could reflect some frustration on the part of the child; for example, "coerced by teacher resulting in changed activity" and "wants an object possessed by another child." Certain speech behaviors in these situations, according to Shames and Sherrick (56), are subject to complex schedules of reinforcement. For example, inconsistent non-reinforcement of a child's verbal demands may reinforce certain forms of phrase, word and/or sound repetition, only later to be punished as an aversive behavior. Unfortunately, very little information is available concerning the effect of nonreward, reward and/or punishment on the fluency of children.

Frustrative Nonreward and Nonspeech Behaviors

The effects of varying reward schedules on nonspeech behaviors of children have been the subject of a number of investigations (51). The results of these studies have often been interpreted in terms of a frustration hypothesis, with frustration being conceptualized as an emotional response which occurs in an organism when nonreward follows a previously rewarded response (1, 64). Skinner (64) states: "When we fail to reinforce a response that has previously been reinforced, we set up an emotional response - perhaps what is often meant by frustration." This definition of frustration appears particularly useful in experimental studies in that the strength of one response class can be quantified and studied as a function of reward conditions. Amsel (1) has indicated that when reward is expected, nonreward is an active factor which he terms "frustrative nonreward." Amsel considers "frustrative nonreward" to have motivational properties which can be measured as an increase in the strength of the response immediately following the nonreward event.

In a sequence of experiments in which rats were used as subjects, Amsel and his associates (2, 3, 4, 43) have demonstrated the activating properties of nonreward. In all of these studies, the experimental situation was essentially the same. Food-deprived rats were trained to run along a runway (R1) to a goal box (G1) where they found food. From (G1) they ran along a second runway (R2) to a second goal box (G2) where they again found food. The time required to run the distance along R2 to G2 was recorded over a series of trials until R2 running time had stabilized. A series of test trials followed, with one half of the rats rewarded and one half of the rats not rewarded with food in G1. The results of these studies indicated that nonreward of the R1 response was followed by shorter R2 running times than those following reward of the R1 response. The difference between the running time performances following nonreward as compared with reward has been referred to as the "frustration effect."

A number of investigations involving children as subjects support Amsel's findings concerning the activating properties of frustrative nonreward (10, 29, 41, 46, 48, 72). 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 with rats except that with children different instrumental response classes, such as lever pulling, are employed.

Ryan (46) and Watson and Ryan (72) studied the effects of frustrative nonreward on level pulling responses of kindergarten children. The apparatus, essentially the same in both of 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). A red light, S1, was the signal to pull R1. A green light, S2, 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; 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 reward or nonreward of the R1 lever pull. These speeds were differentiated according to starting time (time between stimulus onset and the initial movement of the lever) and movement time (time taken to pull the lever throughout its entire excursion).

Ryan (46) divided his kindergarten subjects into two groups. One group (Group 100) received 100 per cent rewards on both R1 and R2 responses, while a second group (Group 50) received 50 per cent rewards on R1 and 100 per cent rewards on R2. The interval between completion of R1 and presentation of S2 was approximately 10 seconds, with an interval of approximately 45 seconds separating each R1-R2 sequence. The 10 second inter-response interval (IRI) allowed the experimenter time to record the R1 response and reset the timers. The 45 second intertrial interval (ITI) was an arbitrarily selected time. It was anticipated that involving a subject in an activity during this time between trials would facilitate the dissipation of any frustration due to a nonreward, prior to the next R1 response. For Group 50, in none of the 5 trial blocks, (of 4 trials each) did the starting speeds for those R2 responses following rewarded R1 responses (R1+) and those following nonrewarded R1 responses (R1-) differ significantly. However, a significant interaction between trial blocks and type of trial variable (R2 following R1+ versus R2 following R1-) for trial blocks 2 through 5 was found. For the second trial block, mean starting speeds for R2 responses following R1+ were greater than those following R1-, but on trial blocks 3, 4, and 5 the opposite was true. For R2 movement speeds, the type of trial variable did not enter into any significant relationships. In all between-group comparisons, the starting and movement speeds of Group 50 for both R1 and R2 were increasingly faster than those for Group 100 over blocks of trials. Watson and Ryan (72), using only one group (50 per cent reward of R1), found significantly higher starting speeds and movement speeds for R2 responses following nonreward than for those following reward in

R1 when R1 and R2 were separated by five-second rather than 10 or 20 second IRI's. ITI's were 30 seconds. The differences were more pronounced for movement speeds than for starting speeds. They indicated the need for a study which would jointly manipulate IRI and ITI in order to provide more systematic evidence concerning the relation between spacing of trials and the duration of the frustration effect.

The importance of an orienting signal preceding the stimulus presentation is considered in two studies by Ryan and his colleagues (12, 47, 48). In a study of preschool subjects by Ryan and Cantor (12, 47) in which no orienting signal was used, starting speeds for Group 50 were slower than those for Group 100 for a considerable number of trials. Ryan and Moffitt (48) using kindergarten and preschool children and a "ready" signal found greater increases in both starting and movement speeds for Group 50 over trial blocks than for Group 100. Ryan and Moffitt speculated that in the Ryan and Cantor study the stimulus signal may have been presented at less opportune times for Group 50 than for Group 100 and that the orienting signal, therefore, may result in a more equal readiness for the stimulus signal for the two groups.

In another investigation (50) Ryan and Watson explored the effects of verbal reinforcers "Good," "Very Good," and "That's Fine" on lever-pulling speeds with one group of children reinforced after every lever-pull and another group rewarded on a random third of the trials. Faster lever-starting and lever-movement speeds over trial blocks for the partially rewarded subject confirmed the results of previous studies using marble reinforcers. A subsequent study by Watson (71) involved lever-pulling responses by kindergarten children subsequent to either ten minutes of social isolation or no social isolation. Lever-pulling responses were reinforced on 0 per cent, 50 per cent, or 100 per cent schedules. Reinforcements were social ("Good") or tangible (candy). Isolation was found to have no effect on performance. Starting speeds under 50 per cent social reward, and movement speeds under 50 per cent tangible reward were shorter than corresponding speeds under 0 per cent or 100 per cent reward.

Ryan (45) employed six reward schedules (100, 83, 66, 50, 33 and 17 per cent) with preschool and kindergarten children. Both lever-starting and lever-movement speeds were faster for kindergarten than for preschool children for all schedules. On movement speeds, Groups 33, 50 and 66 were responding faster than Group 100 by the final block of trials. Significant differences between the various groups were not found with starting speeds. The findings from a subsequent study by Ryan and Voorhoeve (49) for movement and starting speeds supported those of the previous investigation (45). The findings concerning starting speeds are in contrast to the results of previous studies (46, 48) which reported faster starting speeds for 50 per cent rewarded groups than for continuously rewarded groups. They attributed this discrepancy to a procedural difference. In the previous study, the experimenter was located immediately behind the subject in order to reduce disorienting behaviors between trials. In the Ryan and Voorhoeve study, the examiner was located in an adjoining room, which they considered to be less effective for establishing proper orienting behavior.

Deviating from these research designs in which between-group comparisons with different reward schedules were made, Semler and Pederson

(55) used a within-subjects design with first grade children. This design involved a differential conditioning situation where one color of stimulus light was associated with continuous reinforcement (S100 per cent) and a second color of stimulus light was associated with partial reinforcement (S50 per cent). A different random presentation sequence of S100 and S50 was used for each subject. The task sequence involved seeing a red or green light flash on, pushing a button, responding to a tone by releasing the button, and pulling a lever. Measurements were made of initiation speed (speed of releasing the button following onset of tone), travel speed (speed of moving from released button to lever), and movement speed (speed of pulling lever through its full excursion). Findings indicated a significant increase in lever-movement speeds across trial blocks, with faster speeds under the S50 than under the S100 condition. Reinforcement percentage was not a significant factor in the analysis of initiation and travel speed scores.

Frustrative Nonreward and Speech Disfluencies

In contrast to a systematic study of the effects of frustration on non-speech behavior, investigation into the effects of frustration on speech fluency has been largely limited to clinical observations. In discussing aggrevating factors surrounding the problem of stuttering, Johnson (32) suggests that "nothing is to be gained by making (the child's) speech more nonfluent as a result of unnecessary frustrations and disapprovals." Van Riper (69) stresses that "not only can frustration account for the initial breaks in the flow of speech; it also can help us understand why children eventually begin to struggle and avoid." Experimental evidence concerning the effects of frustration on speech fluency has been minimal. Marshall (34) studied the effects of frustrative nonreward on rate of disfluencies in the connected speech of six- and seven-year-old normal-speaking male children. With expectation for reward established, nonreward was introduced according to four different schedules, a different schedule for each of four groups of ten subjects. Each child was shown thirty colored situation pictures to each of which they responded with a story. Following each of the first ten pictures (Condition I), the child was rewarded with the verbal "That's good. Try again," and the dispensing of one candy reward to be accumulated toward the winning of a prize. Following each of the succeeding twenty pictures (Condition II), reward was administered on a 100, 75, 50, or 25 per cent schedule depending upon the group to which the child had been randomly assigned. The story responses were tape recorded and analyzed according to ten categories of disfluency.

Because of certain procedural differences required to obtain connected speech samples, Marshall's investigation was not directly comparable to the studies of frustrative nonreward effects on non-speech behaviors. Partly for this reason, perhaps, significant changes in total disfluency were not obtained when subjects were switched from continuous to partial reward schedules. While most of the differences were small and nonsignificant, subjects switched from continuous to partial reward schedules generally had higher disfluency indices for the various categories of disfluency for responses following nonreward than for those following reward in Condition II except for the category of revisions. In addition, there appeared to be a tendency, as the rates of rewards to nonrewards decreased, for the responses following nonreward to contain an increased proportion of those types of disfluencies more frequently called stuttering and a decreased proportion of those usually considered normal disfluencies. Marshall speculated that one of the effects of frustrative nonreward might be a reduction in the amount of time speakers spend in silent and filled pauses at points of uncertainty in the speech sequence. Jensen (31), while not interested in frustrative nonreward, found no differential effect of reward or punishment on response latencies and durations using aurally presented nonsense syllables with normal-speaking children. He suggests that the failure to observe significant differences might be due to the highly variable latency and duration measures of the children.

Object-Naming Latency

The effects of nonreward on time measurements in speech behavior have been given little consideration. However, efforts to understand some basic aspects of speech behavior have involved time measurements. Fraisse (22) and Oldfield and Wingfield (39) have studied verbal reaction time to understand better the perceptual and coding processes involved in seeing a word or object and naming it. The stimuli used by these investigators with adult subjects have included pictured objects, printed words, and geometric forms.

Using simple single-object pictures and normal adult subjects, Oldfield and Wingfield (39) obtained verbal response latencies for twenty-six objects, the names of which were spread over the range of frequency of occurrence in English usage according to the Thorndike-Lorge List (68). They found that as frequency of occurrence increased, mean verbal response latency decreased, with a resultant linear relationship between mean latency and log frequency of occurrence. Oldfield (38) showed a similar relationship using brain-injured adults.

Wingfield (74) suggested that the naming-latency differences among words could be attributed either to differences in the time required for the visual analysis and perceptual identification of the objects, or to differences in the availability of the objects' names as responses once the perceptual tasks have been completed. Two experiments designed to investigate this matter are reported by Wingfield. In the first experiment, pictures of objects were presented to the subjects tachistoscopically. Visual duration thresholds and response-latencies were obtained. The visual duration thresholds were measures of the amounts of stimulus exposure time necessary for the subjects to detect enough information to identify objects. In the second experiment, a matching-task was used in an attempt to measure the amounts of time required for processing the detected information to complete the perceptual identification of the objects. With adults as subjects, he found that differences in naming-latencies are due primarily to differences in the time occupied in response-selection, rather than in the time required for perceptual identification.

Fraisse (23) attempted to define the characteristics involved in this process of seeing an object and naming it in a slightly different manner. He refers to two aspects of the perceptual process considered easy to measure: (a) the threshold of recognition; and (b) verbal reaction time (the time which passes between the onset of the stimulus and the onset of the response). The thresholds for object recognition were obtained with a tachistoscope. Subsequently, verbal reaction times were obtained for the same objects presented in random order for the same subjects. The threshold of recognition subtracted from the verbal reaction time was considered to result in the duration of the perceptual response. He observed that durations for thresholds of recognition are approximately ten milliseconds while those for verbal reaction times are approximately 500 milliseconds. He noted further the presence of a functional relationship between these two duration measurements. He explained that for a category of stimuli, such as pictured objects or geometric forms, the longer the perceptual response, the higher the threshold.

Fraisse (22) extended his investigation to comparisons of verbal reaction times for object-naming (naming pictured object) and word-naming (reading printed word). He found that average variability in verbal reaction times for adult subjects amounted to approximately 120 milliseconds for word-naming and approximately 325 milliseconds for object-naming. He considered two possible sources of variation, stimulus uncertainty and discriminability, which might contribute to greater variability for object-naming.

Uncertainty, as a function of the number of known possible alternative items expected by the subject, was studied first, using four geometric forms and then twelve geometric forms. He found that verbal reaction time for naming was longer than for reading, and that naming time for the forms increased with an increase in stimulus uncertainty, that is, an increase in number of alternatives. He found, further, that with uncertainty controlled, the naming latency increased with the complexity of the geometric form while the reading latency remained about the same.

Another source of variation considered by Fraisse and his colleagues (24) involves the effect of specific and categorical responses on verbal reaction time. Twenty-four adult subjects were shown the pictures of sixteen stimuli (example: banana) belonging to four categories (example: fruit). They were asked to answer as quickly as possible, in some cases by naming the object, in other cases by stating its correct category. They found that verbal reaction times were consistently longer for the categorical response than for the specific response.

Variables Affecting Reaction Time Behavior

Hundreds of studies have been concerned with the numerous variables which affect reaction time behavior. The following paragraphs concern only a few of the variables which are pertinent to the present study. Garrett (25), Woodworth and Shlosberg (78), and Teichner (67) have presented more complete summaries of the pertinent literature.

Several variables associated with readiness for and presentation of visual stimuli have been considered by investigators. Use of a warning signal prior to stimulus presentation has been considered important by several investigators (48) studying reaction and response times for lever-pulling behavior in preschool and kindergarten-age children. Consideration has also been given to the type of warning signal to be used. Karlin and Mordkoff (33) found that decreased reaction time was obtained when the stimulus modality of the warning signal differed from that of the reaction stimulus. Using a tone and a light, with foreperiods of either 0.5 seconds or 2 seconds, they found that this decreased reaction time with differing warning signal and reaction stimuli was obtained only when the interval between the signal and stimulus was relatively short

(0.5 seconds).

Garrett (25) has considered the foreperiod, or the time-interval between the signal "Ready" and the presentation of the stimulus, to be quite important in reaction time work. He notes that if the foreperiod is less than one second the subject may be unprepared, and if greater than ten seconds the subject is likely to lose his "edge" and react too slowly. He places the optimum foreperiod at approximately one-to-two seconds.

Consideration has also been given to the effect of the time interval between a response (R1) and a succeeding stimulus (S2) on reaction time. Baumeister and Kellas (5) systematically varied the R1-S2 interval from 0.2 second to 5 seconds. S1 was the presentation of a geometric form, with R1 being the naming of this form. S2 was the presentation of a tone, with R2 being the release of a button switch. They found that reaction time to S2 is lengthened when the interval between R1 and S2 is very brief (0.2 and 0.5 second). They refer to this phenomenon as the psychological refractory period.

The rise-time of the visual stimulus to full brilliance has been different among various investigations involving presentation of words, geometric forms, or pictured objects. Oldfield and Wingfield (39) reported that the lamp switched on to illuminate the picture stimulus required 60 milliseconds to reach full brilliance. They indicated that although the full-brilliance time was constant for all subjects, it was not possible to estimate or measure whether factors of perception or recognition were active during that 60 millisecond period.

Two other variables, area and intensity of the visual stimulus, have been studied (25, 78) systematically in association with reaction time experiments involving a simple motor response. With these studies, however, attention has been focused on simple light sources for sensation rather than for perception of objects. Generally, they have found that increases in either area or intensity of light result in shorter reaction times. The various studies dealing with perceptual recognition and naming have approached this variable only by standardizing the area and intensity of the stimulus consistently for all subjects.

Age, as a factor in reaction time, has received little investigation except as related to simple motor behavior. Woodworth and Schlosberg (78) state that throughout the developmental period up to about twenty-five years of age, reaction time decreases, at first rapidly and then more slowly. They note that the young child, with his short nerve pathways and "general liveliness," would be expected to respond very quickly, especially with simple motor responses. They state, however, that:

> it is almost impossible to secure a good series of simple reactions from a child under three years of age. The young child's response is too diffuse and irregular to qualify as the highly integrated, though restricted act which we call the simple reaction.

They observe that factors of emotional excitement and general muscular tension are essentially outgrown by the age of seven or eight.

In summary, principles of learning have facilitated investigations of speech disfluency and its modification. The possibility for excessive disfluency and stuttering having their origins in complex reinforcement and punishment schedules in childhood has been considered. However, very little has been done to study the effects of such schedules on fluency in children. A number of investigations of reward schedule effects on various nonspeech behaviors of children have been reported, often in terms of a frustration hypothesis. Recent efforts to study the adverse effects of frustrative nonreward on children's speech fluency have emphasized the importance of extended study in this area. The present investigation represents an attempt to study the effects of frustrative nonreward on object-naming behavior in children.

CHAPTER III

DESIGN OF THE INVESTIGATION

This study was designed to investigate the effects of nonreward on the object-naming latencies and response durations of children. Two populations of children, normal-speaking and stuttering, were studied. The visual stimuli to which each subject responded included simple-object, line-drawn pictures. The receiving of marbles, to be traded for a prize, constituted the reward. Nonreward, then, was no marble delivery to the subject. Effects of such nonreward were measured in terms of object-naming latency and response duration. The following research questions were formulated for this investigation:

1. Do object-naming latencies differ for responses following nonreward and responses following reward?

2. Do verbal response durations differ for responses following nonreward and responses following reward?

3. Are these differences in the same direction and of the same magnitude for stuttering and nonstuttering children?

Prior to the main experimental condition it was deemed desirable to give the subjects some experience in object-naming, using the experimental equipment and stimulus pictures similar to those to be used in the main experiment. This practice condition was used to obtain data relative to a fourth research question:

4. Is there a linear relationship between frequency of occurrence of words in the English language and object-naming latency for children?

Twenty nonstuttering and eight stuttering male children served as subjects for this study. The normal subjects were obtained from Oklahoma City schools, and neither parent nor teacher reported any concern about their speech. The stuttering children were referred by public school speech therapists and had been identified by the teachers and therapists as stutterers. The normal subjects ranged in age from seven-years, seven-months to nine-years, four-months, with a mean age of eight-years, four-months. The stuttering subjects ranged in age from seven-years, six-months to ten-years, one-month, with a mean age of eight-years, eight-months. The investigation was limited to males due to the higher incidence of stuttering in males, and also to control for any variability in response measures between males and females.

Criterion for selection of subjects included the following: (a) normal articulation, as screened with the Hejna Articulation Test; (b) an I.Q. of at least ninety on the Peabody Picture Vocabulary Test (PPVT), Form A (16); (c) no reported hearing and visual problems. Since stuttering children were difficult to obtain, two individuals were used who did not satisfy the criterion for (b), with PPVT I.Q.'s of eighty-one and eighty-seven.

Procedure

Prior to the experimental tasks, each child was familiarized with the testing room. Several minutes were allowed for conversation about school and summer activities, until the child appeared to be at ease in the situation with the experimenter. He was then shown two practice pictures, mop and tiger. The next thirty-four Single-Picture Practice Condition items were randomized differently for each subject (see Appendix A for sample randomized schedule). The pictured objects were presented with instructions to name each as quickly as possible (see Appendix B for complete instructions). The thirty-four pictures were presented individually at approximately five-second intervals. These items were presented to familiarize the child with a practice naming task similar to the experimental task.

Following a short break, the child was presented Paired-Picture Practice Condition A (see Appendix A) consisting of the only six possible paired-combinations of the pictures boy, bed, and bear (see Appendix C for illustration) to provide practice and familiarization with these three items which were to be used in the Experimental Condition. Three pictures were used, rather than one, in order to insure that the subject would not anticipate the stimulus presentation with a premature response. The instructions prepared him to respond again as quickly as possible, and to expect two pictures, one almost immediately after the other, followed by a short interval before presentation of the succeeding pair of pictures (see Appendix B for complete instructions). Within each pair was a three-to-five second interval, timed from the end of the first response to the presentation of the second stimulus.

A five-minute rest period followed the child's responses to the six paired items whereupon he was introduced to Paired-Picture Practice Condition B (see Appendix A). Four paired-combinations of boy, bed, and bear were presented, preceded by instructions involving how to collect a marble delivered after each response. Each child was informed that if he could collect enough marbles, he would win a prize located in a paper sack on a nearby table (see Appendix B for complete instructions). For the first three pairs both responses of each pair were rewarded with a marble to establish expectation for reward following each response. Nonreward for the first response of the fourth pair was applied to accommodate any unexpected reactions before starting the twenty-four pairs of experimental items. There was no time break between these four paired combinations and the twenty-four experimental pairs.

The Experimental Condition involved the presentation of twenty-four pairs of pictures, where the first responses of the pairs (R1) were rewarded on a 50 per cent schedule and the second response (R2) on a 100 per cent schedule. Each pair was separated by an interval of approximately forty seconds during which the child worked puzzles. Within each pair was a three-to-five-second interval, timed from the end of the first response to the presentation of the second stimulus. The paired stimulus pictures involving reward and nonreward were randomized differently for each subject, with the following restrictions:

1. The three pictures were arranged in pairs in the only six combinations possible: AB, BA, AC, CA, CB, BC. (A = boy, B = bed, C = bear).

2. The first twelve pairs consisted of each of the six possible pairs presented twice, with the twelve pairs randomized. For the two presentations of each of the six possible pairs, one included a rewarded R1 and one a nonrewarded R1.

3. The second twelve pairs consisted of another randomization of the first twelve pairs. Thus, for the total twenty-four pairs, each of the six possible paired combinations occurred four times with R1 twice rewarded and twice nonrewarded.

4. For the first and last pair, R1 was always rewarded.

5. Two pairs in each successive group of four pairs were designated for nonreward following R1.

6. No more than two pairs with nonrewarded R1's or two pairs with rewarded R1's occurred in succession.

7. No identical pairs occurred in succession.

An example of a randomized schedule for the Experimental Condition is contained in Appendix A.

The experimental condition was concluded with the child seeing a blank stimulus (no picture). Announcing the end of the task, the experimenter scrutinized the collection of marbles, indicated to the child that he had accumulated enough marbles to win the prize, and congratulated him on doing so well.

The child was then presented with the standardized instructions appropriate to his age level for the Peabody Picture Vocabulary Test, Form A (16). The test was administered according to the procedure detailed for the test. This was followed by administration of the Hejna Developmental Articulation Test. The total amount of time required for collecting the experimental data from each child was approximately thirty minutes.

Test Stimuli

The test stimuli were thirty-six 35-millimeter slides of single line-drawn objects, considered commonly recognizable by young children. The names of these pictured objects represented a range of most-to-least frequent occurrence in the English language, according to the Thorndike-Lorge frequency distributions (68). Black line-drawn tracings of these objects were made on white tracing paper from commercially prepared picture cards (30). The size of each sketch was relatively uniform. Each line-drawn tracing was photographed individually with Kodachrome II color daylight film, using a single-lens reflex 35-millimeter camera. The camera was mounted on a fixed copy stand, from the same ninety-degree angle and constant distance, with uniform lighting, to assure consistency of size and location of the object on the finished slide.

Presentation of Stimuli

The stimulus pictures were presented using a two-room sound-treated research suite, with the subject and experimenter in one room (experimental) on one side of a window and a Kodak Carousel slide projector, model 800, in the adjoining room (control) on the opposite side of the window. The window surface in the experimental room was fitted with a translucent viewing screen. Against the back of this viewing screen (on the side nearest the window) were mounted two thicknesses of blank-developed x-ray plates in order to minimize glare of the image on the screen. This two-room arrangement eliminated much auditory distraction for the subject.

In order to control for the distance from the viewing screen to the subject's face, as well as to minimize visual distraction, and to control for environmental light intensity, a black-lined viewing hood was positioned against the viewing screen. The viewing screen was blackened, except for a 4.5 inch square aperture. The subject's face was positioned approximately twenty inches from the screen. In a seated position, the subject was able to place his head comfortably against an oval viewing aperture. The projector lamp was uniformly set with the selector switch at 300 watts output.

A shutter device was mounted several inches from the end of the projector lens and was wired for remote activation. This allowed the experimenter to leave the projector lamp on continuously throughout the experiment, but expose the appropriate pictured object only at the specified moment. The shutter consisted of a studio camera iris mounted in its metal frame with a mechanical sliding arm which could be moved along a track to open and close the iris. The metal frame was mounted in a wooden frame. Attached to the wooden frame was a push-pull solenoid with a continuous duty cycle. The core cylinder of the solenoid was secured to the sliding arm of the framed iris. A remote switch permitted activation of the iris to full-open position, allowing the projected picture to be seen on the screen. When the circuit was opened, with release of the switch, a rubber band pulled the iris closed.

The time elapsing between activation of the solenoid-iris assembly and full-open position of the iris was measured to determine the time required for the iris to reach full-open position and, thus, for the complete stimulus to be available to the subject. To make this measurement, a microswitch was mounted on the wooden frame in position to activate a voltage source when the iris reached full-open position. The 115 volt AC signal was reduced to a 4.5 volt signal by a step-down transformer and connected with Channel A of a Sanborn oscillographic strip-chart recorder, model 7702A. A parallel connection with the microswitch in the circuit, was made with Channel B of the recorder, as illustrated in Figure 1. Upon measurement, there was found to be no greater than a one-millisecond delay in this process.

Reward and Nonreward

The receiving of a marble, to be accumulated toward the winning of a prize, constituted a reward. The prize was a toy placed in a small sack in view of the subject. Nonreward, then, was no marble delivery to the subject. Delivery of the reward was accomplished with the use of a Gerbrand marble dispenser, model A, which was mounted above the viewing hood, out of the sight of the subject. Blackened rubber tubing, three-quarters of an inch in diameter, extended from the dispenser's ejection vestibule vertically to a position several inches above the table top inside the viewing hood. By inserting his hand through on aperture on the face of the viewing hood, the subject was able to cup his hand around the end of the tube and to catch the marble as it dropped from the dispenser. The dispenser was activated remotely by a button switch. Another button switch was simultaneously activated, illuminating a ten-watt red signal light which was located behind a black screen just below the viewing screen. This position provided reflection of the light across the lower border of the viewing screen aperture, and served to keep the subject's eyes focused on the screen and ready for the second stimulus picture presentation. The red light was paired with the reward each time the marble was dispensed. When nonreward was scheduled, a white light adjacent to the red light was activated in place of the dispenser and red light.

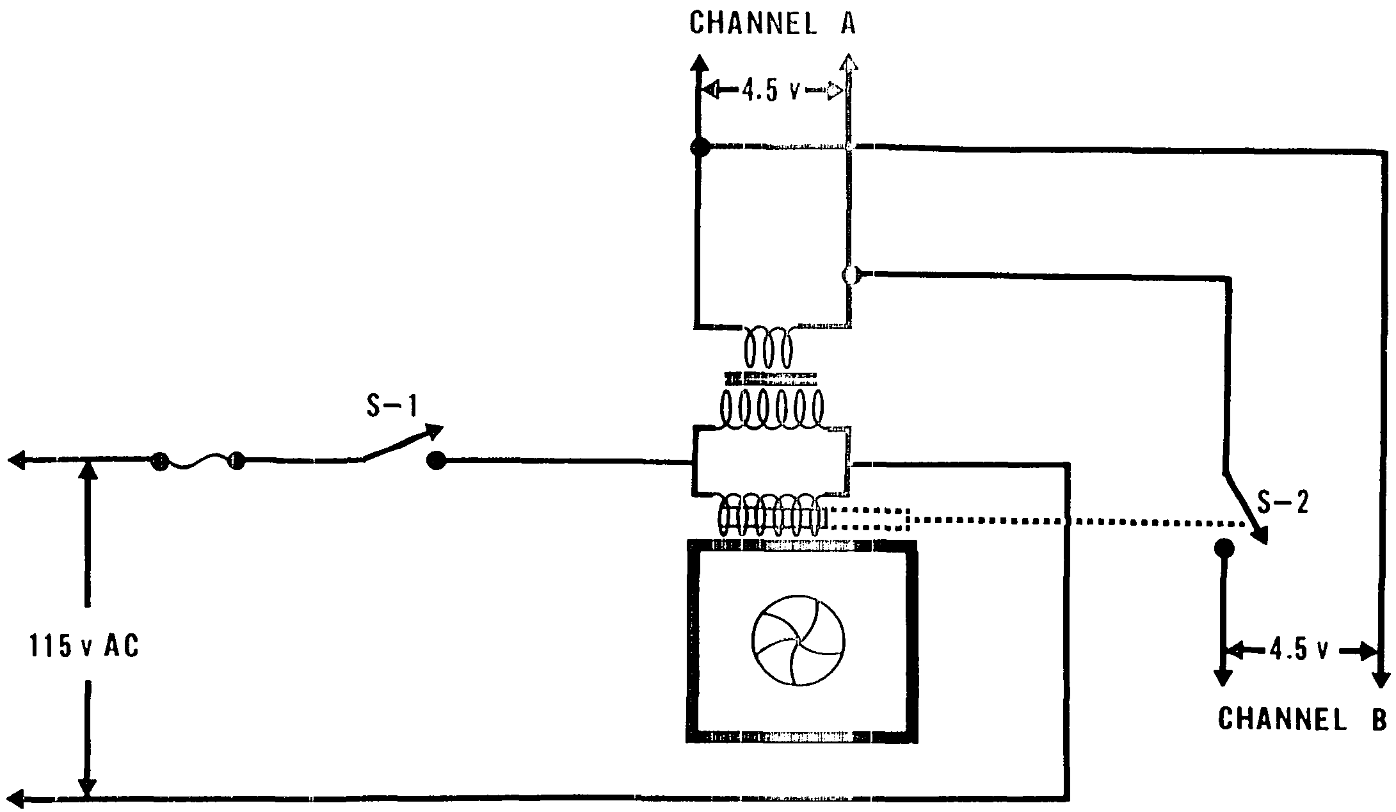


Figure 1. Schematic diagram of the circuit for measuring latency between activation of the solenoid-iris assembly and full-open position of the iris. (S-1) represents the experimenter-activated switch and (S-2), the solenoid-activated microswitch.

Recording of Responses

In order for both object-naming latency and response duration measurements to be made, it was necessary to record subject's vocal responses on magnetic tape. At a later time, then, the taped samples could be transferred to strip-chart recordings for measurements. The recording for such measurements involved the use of an Ampex two-channel tape recorder, model 440, a stimulus signal source, and a microphone. The remote activation of the voltage source, which opened the iris for presentation of the stimulus picture, simultaneously initiated a 60 Hz line signal to Channel B of the tape recorder. The verbal naming response was picked up by an Electro-Voice cardioid microphone, model 664, and was recorded on Channel A of the same tape recorder. The tape recorder was located in the control room, with the record mode activated by a remote control switch located in the experimental room. The microphone was located in the experimental room inside the viewing hood and just below the oval aperture for the subject's face. The microphone was covered with black mesh material to minimize the possibility that it would distract the subject. An approximate mouth-to-microphone distance of six inches was maintained.

The recorded speech samples were later transferred to a Sanborn oscillographic strip-chart recorder, model 7702A, for the object-naming latency and response duration measurements. Signal amplitude settings on both the Ampex tape recorder and the Sanborn recorder were uniform for all subjects' taped responses. Paper speed was 100 millimeters per second. Each taped sample was uniformly cued, so that at least 30 millimeters preceded onset of the stimulus voltage. This delay assured that peak paper speed (reached within 10 millimeters) was constant before the signal was recorded. The stimulus voltage was recorded on Channel B, with the verbal response voltage to Channel A.

Object-Naming Latency

Object-naming latency was defined as the number of milliseconds from the onset of the stimulus to the onset of the response (see Figure 2, I a-b). Stimulus onset was defined as the point of shift from baseline, initiating a visual recording of the 60 Hz line voltage (Figure 2, I a).

Onset of word production for the latency measurement was defined as the following: (a) the sudden transition from a 60 Hz line signal to a higher frequency signal which may or may not initially involve a greater amplitude than the preceding line signal (Figure 2, I b, V b); (b) the point from which continuous increase in amplitude occurs for at least 50 milliseconds, exceeding the amplitude of the previous line signal, before decreasing and/or changing to a higher frequency signal (Figure 2, II b); and (c) sounds of articulators contacting or separating, respiration, or subvocalizations which are printed out as signals connecting or immediately preceding the response signal within 50 milliseconds (Figure 2, III b, IV b). All strip-chart recordings were carefully monitored visually while listening to the auditory signal from the tape recorder. Ultimately, all questionable response signal characteristics were clarified and resolved with such visual and auditory monitoring.

Response Duration

Response duration was defined as the time, in milliseconds,

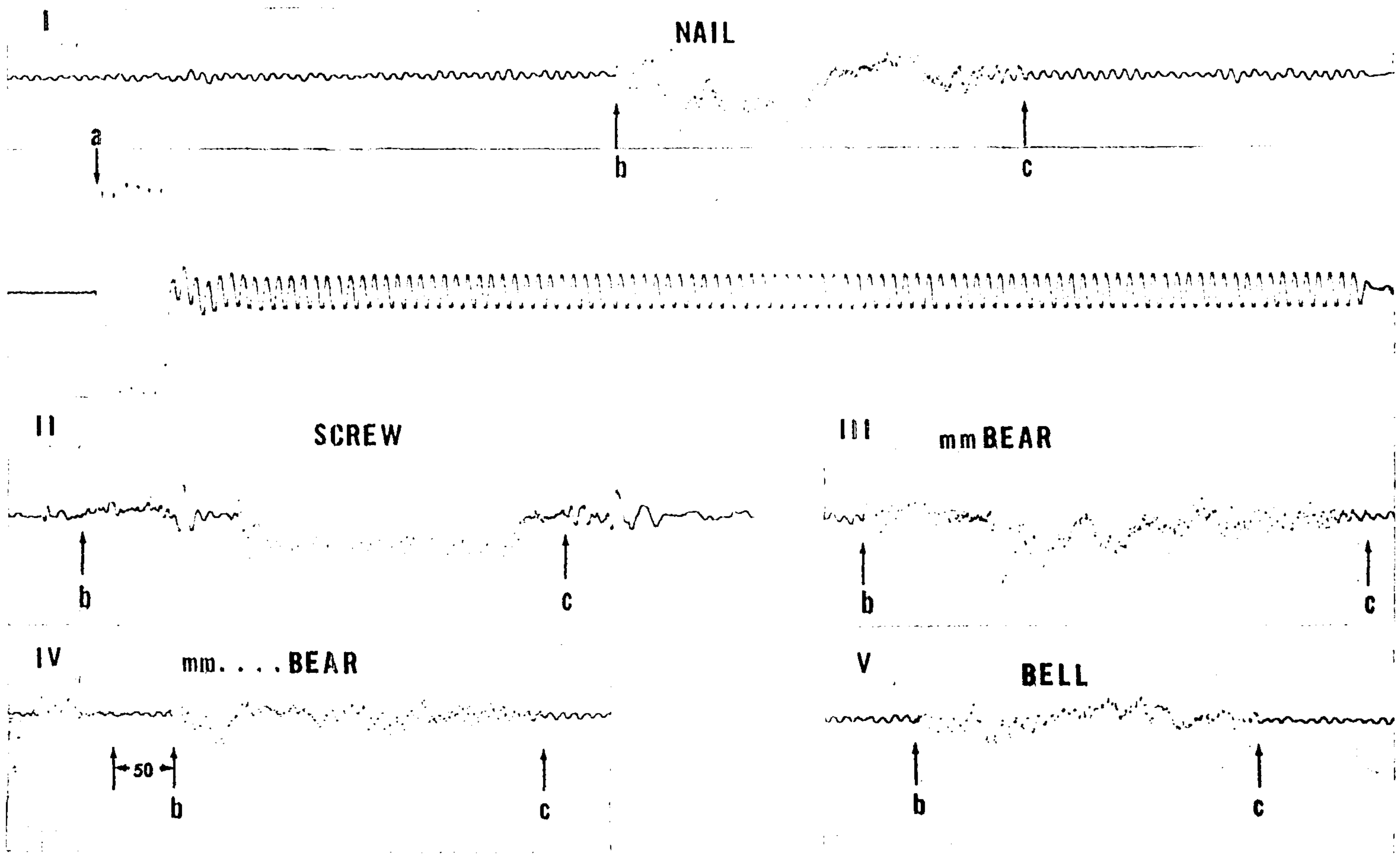


Figure 2. Examples of the strip chart recordings for five single-word responses, demonstrating the definition of the onset and termination points of words, as well as the stimulus onset.

required to make the single-word response (Figure 2, I b-c). Criteria for onset of word production were the same as those enumerated for object-naming latency measurement. Termination of the response was defined as the following: (a) the sudden transition from a high frequency signal to a 60 Hz line signal which may or may not initially involve a smaller amplitude than the preceding signal (Figure 2, IV c, V c); and (b) the sudden transition from a high frequency signal to a transient signal, visually and auditorily monitored as the sound either of articulators separating or of respiration occurring (Figure 2, II c).

Rationale for Various Latency Versus Frequency Analyses

Oldfield and Wingfield (39) found that the mean time taken for normal-speaking adults to name pictures of objects is linearly related to the logarithm of word frequency of occurrence in the English language as estimated in the Thorndike-Lorge Word List (68). It was desired in the present study to determine whether a similar relationship exists for normal-speaking and for stuttering children.

Before investigating the relationship between object-naming latency and word frequency for children, several questions needed to be answered. First, should the mean be used, as Oldfield and Wingfield (39) did, as the statistic for quantifying the average object-naming latency or should the median be used? While the mean may have been satisfactory with data from adults it might not be a good statistic for use with the data from children. Reaction time studies involving nonverbal tasks have generally found children to be much more variable in reaction time than are adults (78). In order to avoid the undue influence of extreme values on the measure of central tendency, it might be better to use the median with children's data. For this reason medians as well as means were employed in this part of the study.

Second, the authors Oldfield and Wingfield (39) used the Thorndike-Lorge Word List's (T-L) adult norms. The T-L frequency distributions have been differentiated according to occurrence of words in general reading material appropriate to adults and according to material appropriate to children. The frequency of a given item differs, of course, depending on whether the adult or juvenile norms are used. It would seem that the appropriate norms to use in the present study would be the juvenile norms. In view of the influence of television, radio, and moving pictures on the language of children, there is reason to believe, perhaps, that the juvenile norms presented by Thorndike and Lorge over a quarter of a century ago may be more outdated than are the adult norms. In fact, one might speculate that the actual frequency distribution of word occurrence for juveniles today may more closely approximate the adult distribution than the juvenile distribution of twenty-five years ago. For this reason both the adult and juvenile norms were used in this study.

Third, in their analyses Oldfield and Wingfield (39) used all the responses of their subjects which involved the correct naming of the items. Thus, while individual responses involving misnamings were eliminated from analyses, no stimulus words were eliminated. None of the items used by them were misnamed by more than two of their twelve subjects, and most items were named correctly by all subjects. A higher incidence of misnaming might be expected for children, due either to greater differences in their vocabularies or to differing degrees of ambiguity in the pictured items. By "ambiguity" is meant that some pictured items may have several common names, although an attempt was made to avoid this in selecting the pictures. Those items which are frequently misnamed might be thought to have a high degree of ambiguity and might tend to have longer than average latencies even when the desired name is given to the object. For this reason it was desired to study the relationship between latency and word frequency using both the complete word list, as did Oldfield and Wingfield, and also to use an adjusted word list from which frequently misnamed items had been excluded. An inspection of the number of correct and incorrect namings given by the subjects in this study suggested a criterion of 20 per cent to be reasonable; that is, all items misnamed by 20 per cent or more of the subjects in each group were excluded from the analyses for that group. Thus, at least seventeen of the normal-speaking children and six of the stutterers had to name the pictured object correctly for the word to be included in the adjusted list. This resulted in the elimination of eleven items for the normal-speaking children and eight items for the stuttering children.

Reliability of Measurement

To check the reliability of the measurements, an independent judge who was familiar with the criteria listened to randomly selected taped samples and then measured the corresponding latencies and response durations from the oscillographic strip-chart recordings for five subjects (three normals and two stutterers) selected at random. For each of these subjects, measurements were made for nine object-naming latencies and their corresponding response durations for responses in the Experimental Condition, and for five object-naming latencies from the thirty-four items in the Single-Picture Practice Condition. Therefore, a total of seventy object-naming latency and forty-five response duration measures were made by two judges.

Differences were computed between measurements made by the first and second judges for the latencies and response durations for these items. As shown in Table 1, sixty-three out of seventy object-naming latency measurements and twenty-two out of forty-five response duration measurements were within five milliseconds of agreement. Interjudge reliability was considered highly satisfactory for the object-naming latency measurements and less so for the response duration measurements. Poorer reliability of response duration measurements appeared due primarily to difficulty in identifying the termination of the responses rather than the onset of responses.

TABLE 1

INTERJUDGE DIFFERENCES IN OBJECT-NAMING LATENCY AND RESPONSE DURATION MEASUREMENTS (IN MILLISECONDS)

Interjudge Measurement Differences (millisec.)	Number of Differences (70 Latency Measures)	Number of Differences (45 Duration Measures)
0	28	10
5	35	12
10	3	4
15	2	2
20	0	2
25 - 100	1	12
100 - 200	1	2
200 - 300	0	1

CHAPTER IV

RESULTS AND DISCUSSION

Results

This study explored the effects of nonreward on the object-naming latencies and response durations of children. Twenty normal-speaking and eight stuttering males provided naming responses to twenty-four randomized pairs of simple-object line-drawn pictures, where the first responses of the pairs were rewarded on a 50 per cent schedule and the second responses on a 100 per cent schedule. The stimuli consisted of pictures of *boy*, *bed*, and *bear*. The randomization schedules for the pairs of pictures differed from subject to subject. Latency and response duration measurements were made.

This experimental task was preceded by the presentation of a series of thirty-six simple-object pictures. The first two picture presentations (*mop* and *tiger*) were practice items. The next thirty-four pictures were presented according to a different random schedule for each subject. Presentation of these pictures served a dual purpose: (a) to familiarize the child with a naming task, having a stimulus-response set similar to the experimental task; and (b) to provide data for determining the relationship between object-naming latency and the frequency of occurrence of the object-name in the English language, based on the

Thorndike-Lorge (T-L) frequency distributions (68).

Relationship Between Object-Naming Latency and Frequency of Occurrence of Words

Object-naming latency measurements were obtained for each subject for each response involving a correct naming for the 34 randomly presented pictures. The object-naming latency measures for each picture for each subject are contained in Tables 8 and 9 in Appendix D. No responses involving misnamings were used in any of the analyses. In Table 2 are presented the stimulus words, their frequencies of occurrence according to the T-L adult and juvenile norms, the mean and median latencies (in milliseconds), the standard deviations (in milliseconds), and the number of subjects correctly naming each item for the normal speakers and for the stutterers. Two of the words in the adult list, paintbrush and screwdriver, were not contained in the T-L juvenile word list. The mean object-naming latency across subjects for all correctly named words was 1359 milliseconds for the normal-speaking children and 1264 milliseconds for the stuttering children. A comparison of the means and medians for the words indicates that for some words, such as gum and magnet for the normals and carrot for the stutterers, the distributions of object-naming latencies were greatly skewed, with correspondingly large standard deviations.

Since the stimulus words were chosen to cover a wide range of frequency of occurrence, lines of regression of object-naming latency on logarithm_{10} frequency of occurrence were obtained and are presented in Figures 3-6 for the 16 combinations of the four factors: normals and stutterers, adult and juvenile norms, means and medians, and complete

TABLE 2

STIMULUS WORDS, THORNDIKE-LORGE (68) WORD FREQUENCIES ACCORDING TO ADULT AND JUVENILE NORMS, MEAN AND MEDIAN OBJECT-NAMING LATENCIES (IN MILLISECONDS), STANDARD DEVIATIONS (IN MILLISECONDS) AND THE NUMBER OF CORRECT RESPONSES TO EACH WORD (N) FOR NORMAL-SPEAKING AND STUTTERING SUBJECTS

Stimulus Words	Frequency		Object-Naming Latency: Normals				Object-Naming Latency: Stutterers			
	Adult	Juvenile	Mean	Median	N	SD	Mean	Median	N	SD
1. door	100+[a]	1000+[b]	1190	1085	20	365	949	910	7	216
2. boy	100+	1000+	1054	995	20	208	932	1010	7	198
3. bear	100+	1000+	1242	1215	17	282	1323	1105	8	713
4. bed	100+	1000+	1024	918	20	346	939	905	8	236
5. man	100+	1000+	1233	1135	15	369	1173	1113	4	272
6. ball	100+	750	948	950	10	243	971	948	6	215
7. dog	100+	700	1153	1040	19	343	1118	1210	7	255
8. ring	100+	700	1090	1085	20	216	985	928	8	158
9. bee	50-100[c]	330	1098	1060	19	280	1137	1025	7	400
10. bell	50-100	350	1083	960	20	299	1111	1070	7	311
11. nail	50-100	246	993	898	20	309	979	820	8	312

TABLE 2--Continued

Stimulus Words	Frequency		Object-Naming Latency							
			Normals				Stutterers			
	Adult	Juvenile	Mean	Median	N	SD	Mean	Median	N	SD
12. doll	46	210	1118	1025	19	238	1231	1210	6	373
13. feather	44	252	1442	1225	11	557	1341	1278	4	379
14. drum	40	280	1265	1070	20	623	949	933	8	185
15. deer	35	220	1339	1030	19	600	1141	1025	8	265
16. pear	21	97	1547	1475	17	555	1236	1190	5	360
17. screw	20	124	1647	1433	14	670	1433	1385	6	380
18. ladder	19	0	1202	1035	20	389	1320	1055	7	550
19. camel	18	157	1417	1045	20	1464	1156	1215	8	240
20. garage	14	2	1505	1475	16	233	1518	1490	5	409
21. rake	13	13	1384	1290	18	487	1475	1460	7	243
22. turtle	13	13	938	928	20	155	1038	930	8	296
23. broom	13	13	1793	1310	17	1224	1422	1140	7	640
24. pumpkin	13	37	1825	1495	16	910	1659	1775	7	236
25. violin	11	34	1618	1635	9	447	1333	1310	5	175

TABLE 2--Continued

Stimulus Words	Frequency		Object-Naming Latency							
			Normals				Stutterers			
	Adult	Juvenile	Mean	Median	N	SD	Mean	Median	N	SD
26. gum	11	31	2409	1495	12	2829	1745	1590	5	804
27. magnet	9	46	3091	1915	17	2522	1730	1645	6	459
28. mitten	9	8	1329	1160	14	459	1408	1290	2	338
29. carrot	9	13	1047	1008	20	234	1909	1080	7	2184
30. rooster	6	13	1373	1320	13	415	1372	1390	5	459
31. zebra	2	23	1175	1020	20	414	969	940	8	209
32. toaster	1	1	1358	1178	20	595	1439	1130	8	703
33. paintbrush	.33	....[d]	1451	1230	15	524	1941	1633	6	980
34. screwdriver	.33	....	1718	1650	20	658	1499	1485	6	384

[a]Frequency of 100+ per 1,000,000 words of text.

[b]Frequency of 1000+ words according to a selected list of children's reading material.

[c]Frequency of 50 to 100 per 1,000,000 words of text.

[d]Words not presented in the Juvenile List.

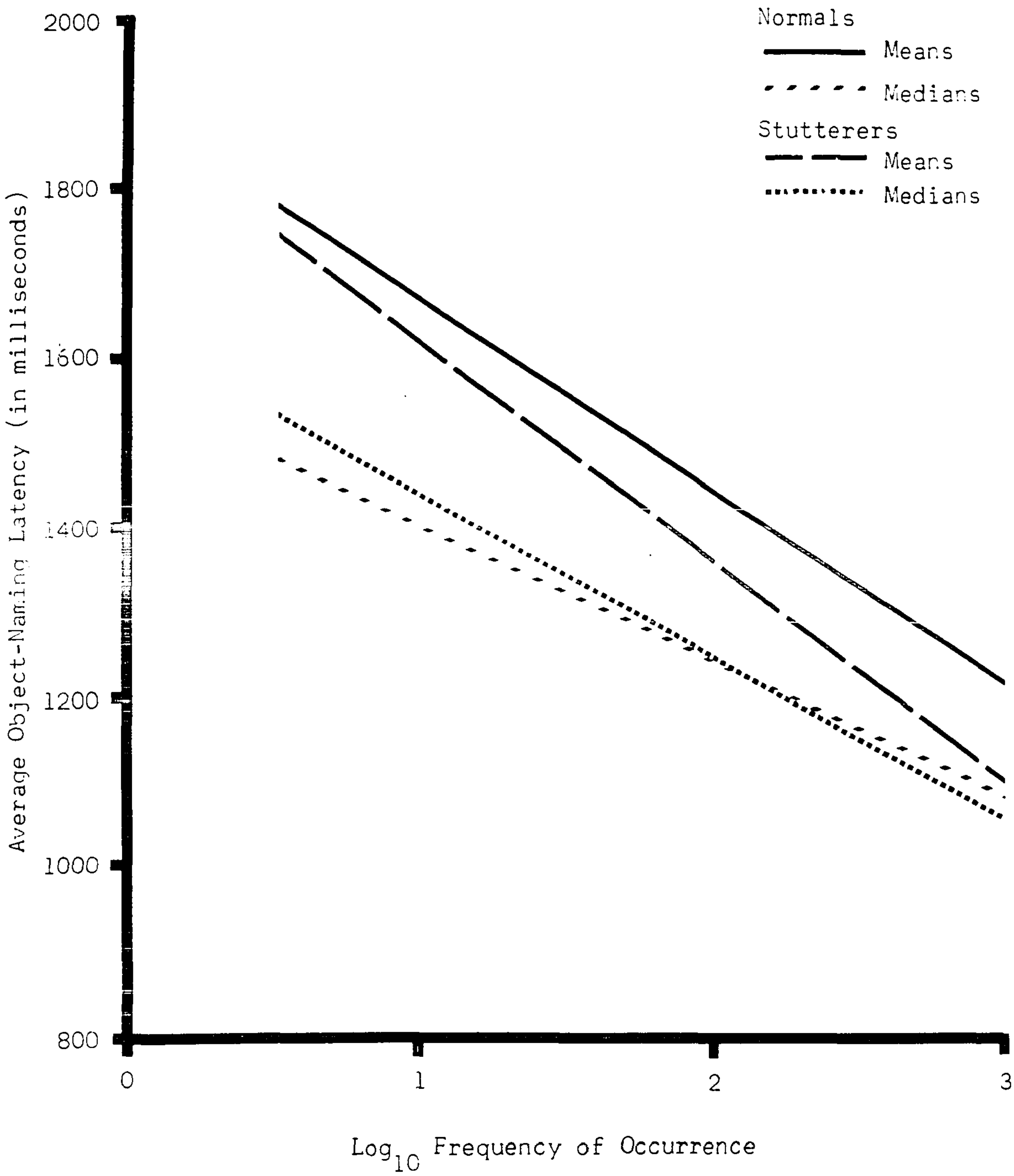


Figure 3. Lines of regression of object-naming latency on logarithm$_{10}$ frequency of occurrence, according to adult norms, complete list, mean and median latencies (in milliseconds), for normals (N=20) and stutterers (N=8).

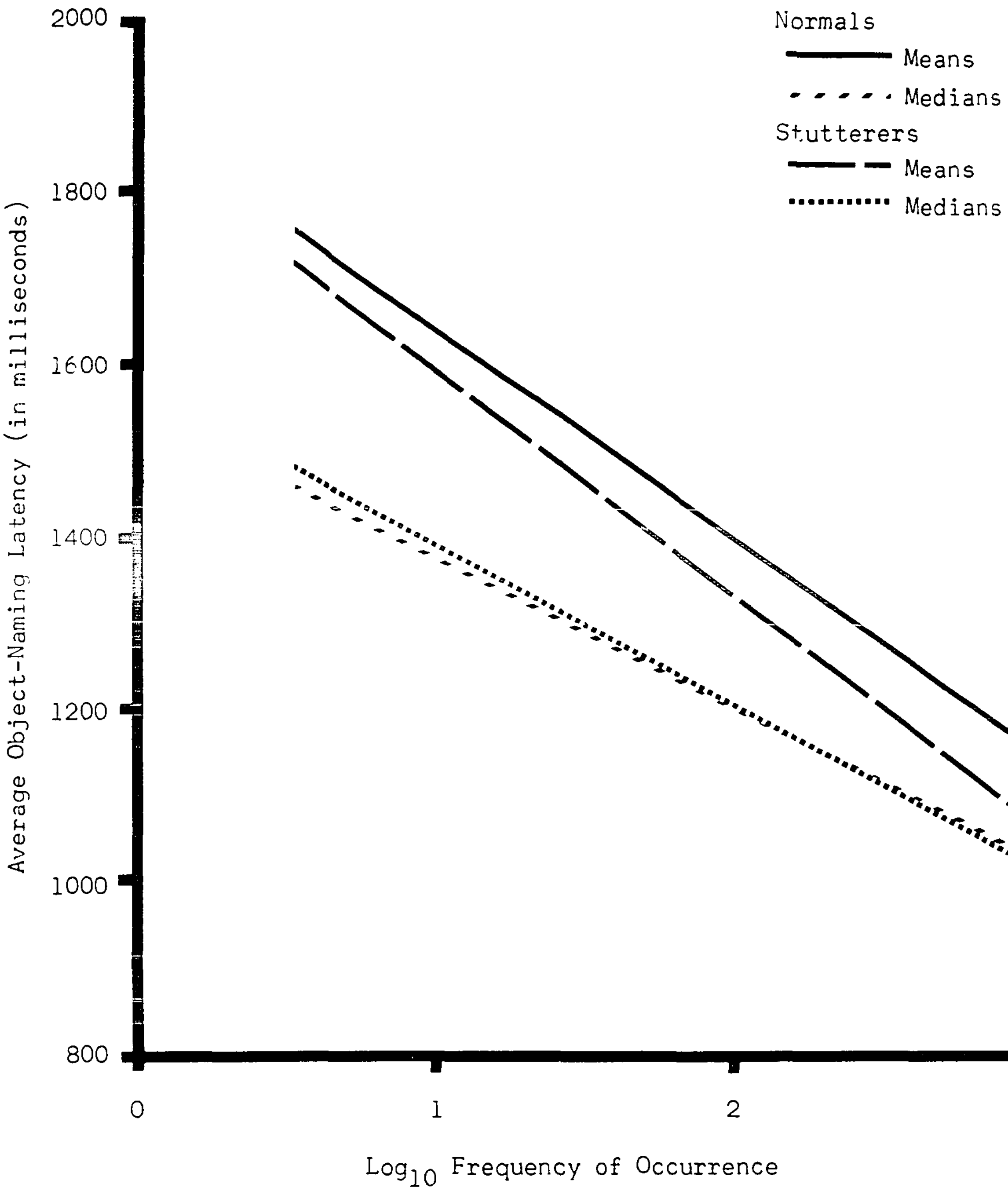


Figure 4. Lines of regression of object-naming latency on logarithm$_{10}$ frequency of occurrence, according to adult norms, adjusted list, mean and median latencies (in milliseconds), for normals (N=20) and stutterers (N=8).

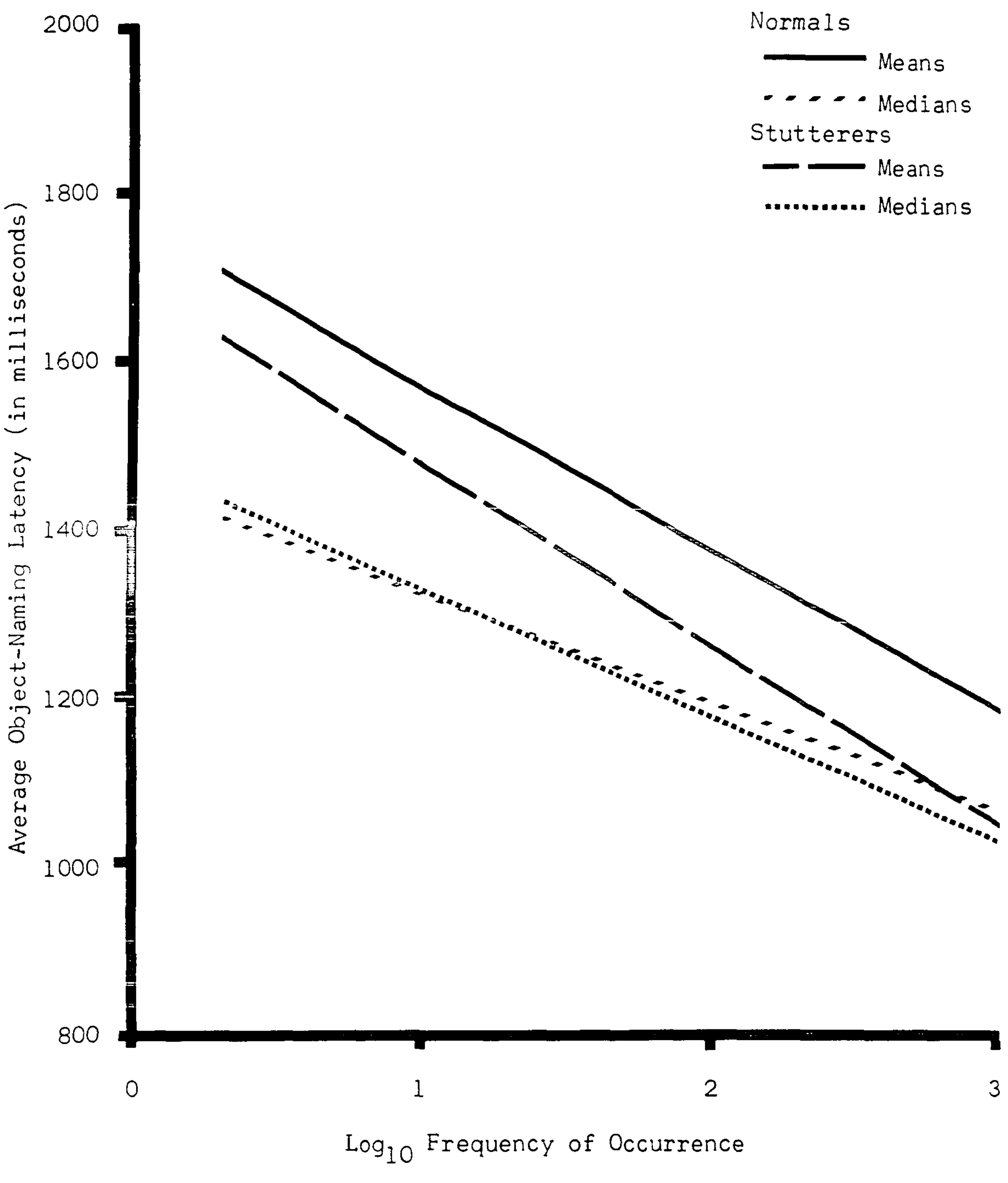


Figure 5. Lines of regression of object-naming latency on logarithm$_{10}$ frequency of occurrence, according to juvenile norms, complete list, mean and median latencies (in milliseconds), for normals (N=20) and stutterers (N=8).

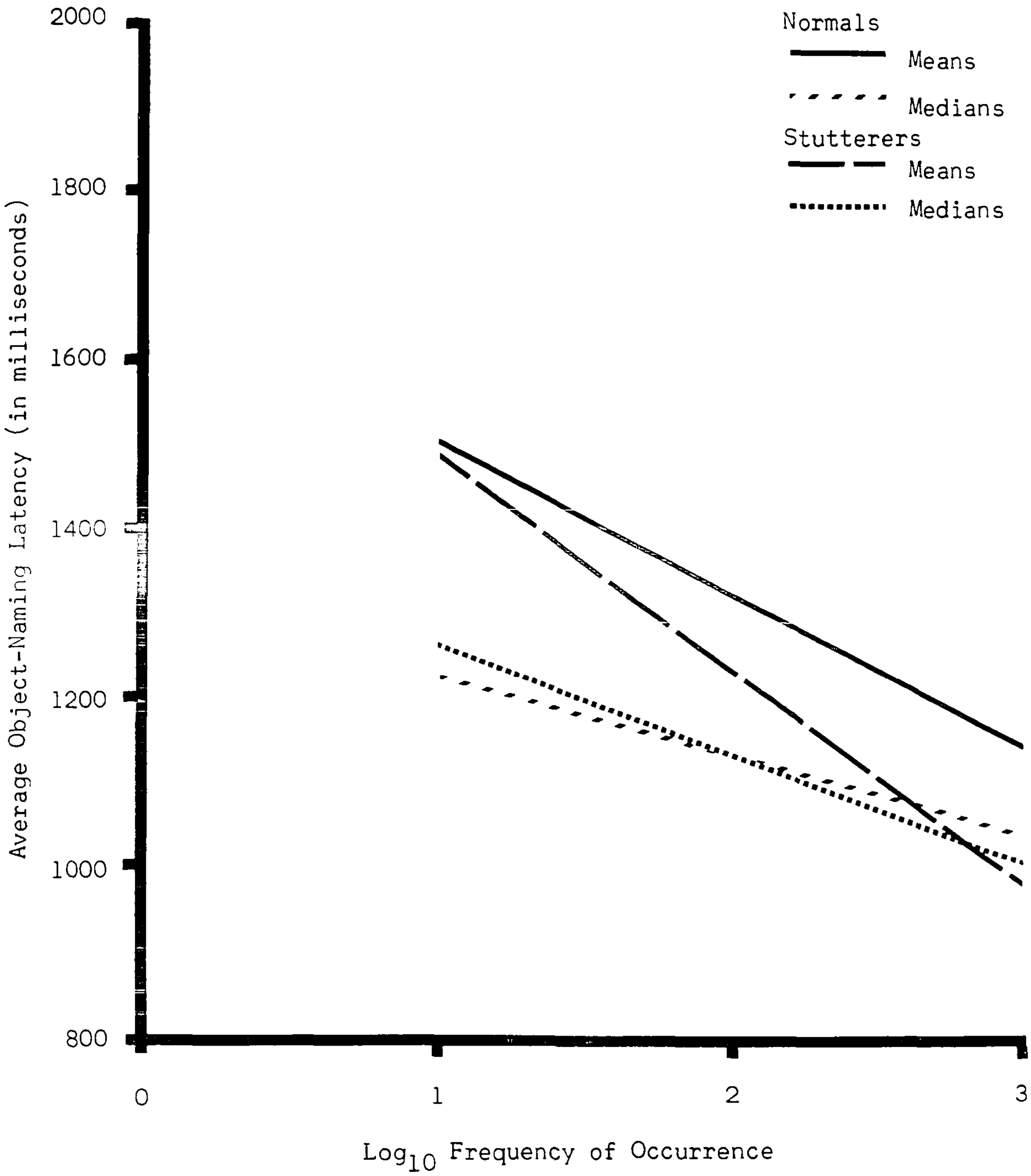


Figure 6. Lines of regression of object-naming latency on logarithm$_{10}$ frequency of occurrence, according to juvenile norms, adjusted list, mean and median latencies (in milliseconds), for normals (N=20) and stutterers (N=8).

and adjusted word lists. An examination of the lines indicates that the time taken by children, normals or stutterers, to name objects is negatively correlated with the logarithm of the frequency of occurrence of the names in the English language. The absolute values of the slopes of the lines are generally slightly greater for stutterers than for normals, for means than for medians, and for the adult norms than for the juvenile norms.

The differences of the slopes of the obtained regression line from zero slope were tested for significance using regression analysis procedures. The obtained significance levels are the same as those reported for the Pearson product-moment correlation coefficients presented in Table 3 for the corresponding comparisons. For the normal-speaking subjects four of the eight correlation coefficients are significantly different from zero ($P < .05$), three of the four significant correlations being for the data for the complete list, three of four involving adult norms, and three of four involving medians. For the stuttering subjects, seven of the eight correlation coefficients were significantly different from zero ($P < .01$), the only nonsignificant correlation being the one involving the adjusted list, juvenile norms, and medians. Within each group of subjects the differences between correlation coefficients were generally small. In all cases the correlation coefficients for the stuttering subjects were higher than the corresponding coefficients for the normal-speaking subjects.

Relationship Between Object-Naming Latency and Chronological Age and PPVT IQ Score

The question arises as to whether object-naming latency may be

TABLE 3

PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS FOR AVERAGE OBJECT-NAMING LATENCY (IN MILLISECONDS) AND LOG_{10} FREQUENCY OF OCCURRENCE OF WORDS

	Normals		Stutterers	
	Adult Norms	Juvenile Norms	Adult Norms	Juvenile Norms
Complete List	(N=34)	(N=31)	(N=34)	(N=31)
Means	- .35[a]	- .34	- .62[b]	- .63[b]
Medians	- .44[a]	- .43[a]	- .52[b]	- .50[b]
Adjusted List	(N=23)	(N=21)	(N=26)	(N=23)
Means	- .36	- .29	- .63[b]	- .63[b]
Medians	- .47[a]	- .29	- .53[b]	- .38

[a] $P < .05$

[b] $P < .01$

related to chronological age. Though this study was not designed to adequately answer this question and the age range of the subjects used was only about two years, the degree of the relationship was examined. Using the 14 items named correctly by all the normal-speaking subjects and the 10 items named correctly by all the stutterers, Spearman rank-order correlation coefficients were obtained (see Table 4) to estimate the relationship between mean object-naming latency and chronological age. For both normals and stutterers the obtained correlation coefficients were nonsignificant. When examined in terms of the 4 most and the 4 least frequent items for the normals, and the 2 most and 2 least frequent items for the stutterers, the correlation coefficients were still statistically nonsignificant. There did appear to be a tendency, however, particularly for the least frequent words, for mean object-naming latency to decrease as chronological age increased. Nonsignificant correlation coefficients were also obtained when mean object-naming latency was correlated with PPVT IQ scores (see Table 4).

Effect of Reward and Nonreward on Object-Naming Latency and Response Duration

The experimental condition involved the randomized presentation of twenty-four pairs of pictures. Fifty per cent of the subject's first responses (R1) of the paired responses were rewarded. One-hundred per cent of the second responses (R2) of the paired responses were rewarded. For the total twenty-four pairs, mean object-naming latency and mean response duration measurements were obtained for the R1's, R2's, R2's following reward (R2+), and R2's following nonreward (R2-) for normals and stutterers, as shown in the columns headed Pairs 1-24 in Table 5. Mean

TABLE 4

SPEARMAN RANK-ORDER CORRELATION COEFFICIENTS FOR MEAN LATENCY VERSUS CHRONOLOGICAL AGE (CA) AND MEAN LATENCY VERSUS PPVT IQ SCORE FOR NORMALS AND FOR STUTTERERS, FOR THE ITEMS NAMED CORRECTLY BY ALL SUBJECTS (14 FOR NORMALS, 11 FOR STUTTERERS) AND FOR THE 4 MOST (4+) AND 4 LEAST (4-) FREQUENT ITEMS FOR THE NORMALS AND THE 2 MOST (2+) AND 2 LEAST (2-) FREQUENT FOR THE STUTTERERS

	Normals			Stutterers		
	14	4+	4-	11	2+	2-
Latency vs CA	.00	.04	-.33	-.41	-.33	-.41
Latency vs IQ	-.27	.19	-.33	.24	.14	-.10

TABLE 5

MEAN OBJECT-NAMING LATENCY AND MEAN RESPONSE DURATION MEASUREMENTS (IN MILLISECONDS) FOR R1, R2, R2 FOLLOWING REWARD (R2+), R2 FOLLOWING NONREWARD (R2-), FOR NORMALS AND STUTTERERS, FOR PAIRS 1-24, PAIRS 1-12 (BLOCK I), AND PAIRS 13-24 (BLOCK II)

	Pairs 1-24				Pairs 1-12 (Block I)				Pairs 13-24 (Block II)			
	R1	R2	R2+	R2-	R1	R2	R2+	R2-	R1	R2	R2+	R2-
Latency												
Normals	721	753	757	749	709	750	737	763	736	756	777	736
Stutterers	634	732	733	731	625	667	665	669	651	793	796	791
Duration												
Normals	445	454	455	452	437	445	444	445	454	469	466	471
Stutterers	421	409	407	412	403	393	395	391	431	425	417	434

object-naming latency and response duration measures for individual subjects are contained in Table 7 in Appendix C.

Of primary interest in this study was the effect of reward and nonreward on object-naming latencies. An inspection of the means in Table 5 for Pairs 1 to 24 shows the differences between mean R2+ and mean R2- for latencies for both normals and stutterers to be very small, the largest difference being only 8 milliseconds. Considering that the measurements were made to the nearest 5 milliseconds, these means do not suggest a differential effect of reward and nonreward on object-naming latency as defined by the procedures used in this study.

In view of Ryan's (46) finding of a significant interaction between trial blocks (of four trials each) and variables (R2+ versus R2-) for starting speeds, the question arises as to whether an interaction may not exist in the present study if the twenty-four pairs were broken into blocks of pairs. Since the second twelve pairs were a re-randomization of the first twelve pairs, the twenty-four pairs were broken into two blocks, with Block I consisting of pairs 1 to 12 and Block II consisting of pairs 13 to 24. Mean object-naming latencies for the R1's, R2's, R2+'s, and R2-'s for Blocks I and II are presented in Table 5 and are plotted in Figure 7. Inspection of the mean R2+ and R2- latencies for normals for Blocks I and II suggests a crossover effect or interaction similar to that obtained by Ryan. Differences between mean R2+ and R2- latencies within both Blocks I and II appear very small.

To test for significance the interaction of the mean R2+ and R2- latencies for Blocks I and II for the normal subjects, a three-factor factorial analysis of variance was performed. A summary of the analysis

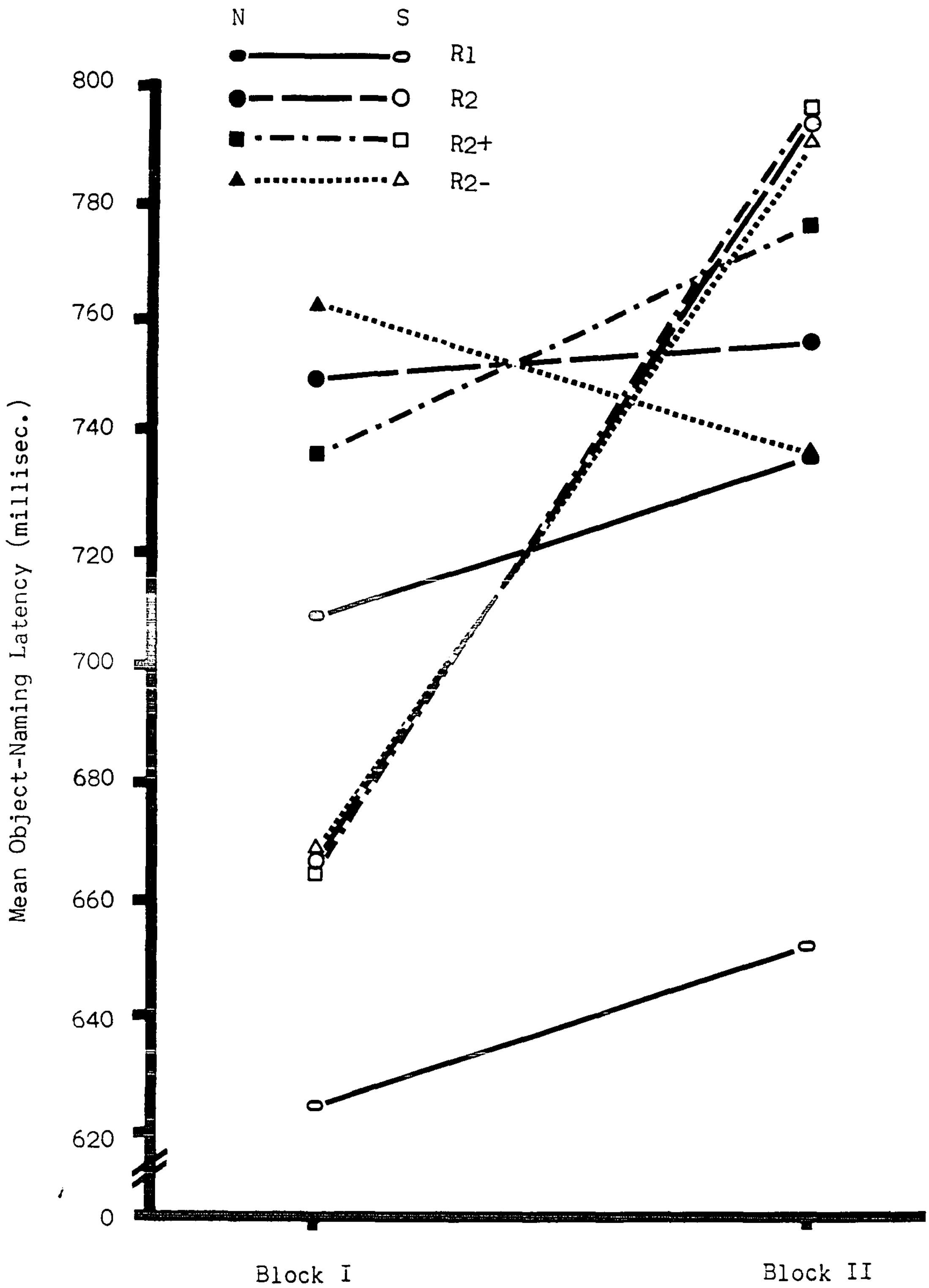


Figure 7. Mean object-naming latencies (in milliseconds) for R1, R2, R2+, and R2- for Block I (Pairs 1-12) and Block II (Pairs 13-24), for normals (N) and stutterers (S).

of variance is reported in Table 6. The Rewards (R2+ versus R2-) by Blocks interaction can be seen to be nonsignificant. The Wilcoxon Matched Pairs Test was also applied to the R2+ and R2- values for Blocks I and II for the normal subjects' latency measures and likewise showed the interaction between Rewards and Blocks to be nonsignificant at the .05 level. In the analysis of variance, the Rewards main effect refers to the difference between the R2+ and R2- means for Pairs one to twenty-four. The $\underline{F}$ is nonsignificant at the .05 level. A repetition of these statistical procedures for R2+ and R2- differences for the stutterer's latency means was not performed in view of the small differences presented.

The relatively large error variance (R X B X P) in the analysis of variance summarized in Table 6 suggests that the rewards and blocks factors may affect individual subjects quite differently. While the group means appeared to evidence a Rewards by Blocks (though not significant) interaction, only nine of the twenty normal subjects evidenced a similar effect in their individual means. Eight of the normals maintained the same relation between their R2+ and R2- mean latencies from Blocks I to Block II and three subjects had Rewards by Blocks interactions which were opposite to that for the group means.

For both normals and stutterers, R2 latencies are longer than R1 latencies. For stutterers, significant ($P < .05$) $\underline{t}$'s were obtained for the differences between R1 and R2 for pairs 1 to 24 and for Block II; a nonsignificant $\underline{t}$ was obtained for Block I. For the normals, nonsignificant $\underline{t}$'s were obtained for the differences between R1 and R2 for pairs 1 to 24, for Block I, and for Block II.

The question arises as to whether the observed increases from

TABLE 6

SUMMARY OF ANALYSIS OF VARIANCE FOR R2+ AND R2- OBJECT-NAMING LATENCIES FOR BLOCKS I AND II FOR NORMAL SPEAKING SUBJECTS

Source	df	MS	F[a]
Rewards (R)	1	1036.80	.05
Blocks (B)	1	938.45	.04
Persons (P)	19	42308.68	1.96
R X B	1	21978.45	1.02
R X P	19	10412.66	.48
B X P	19	10844.70	.50
Error (R X B X P)	19	21631.90	
Total	79	20793.85	

[a]All obtained *F*'s nonsignificant at .05 level.

mean R1 to mean R2 might be related to the 50 per cent reward schedule for R1; that is, is there a tendency for partial reward of R1 to result in a longer latency for R2 responses? Or, could it be that it is the pairing itself of naming tasks or some other factor which results in a tendency for longer latencies for R2 responses? While the six pairs in Paired-Picture Practice Condition A were intended primarily for practice purposes, mean object-naming latencies were obtained for these responses to discover whether the same trends occur for these pairs, for which the possibility of reward had not been mentioned, as for the experimental pairs. For the normal-speaking subjects, the mean R1 latency (797 ms) was significantly ($\underline{t}$, $P < .001$) higher than the mean R2 latency (717 ms). Only 2 of the 20 normals showed an increase in mean latency for R1 to R2 for the practice pairs while 13 of the 20 showed an increase for the experimental pairs. For the stuttering subjects, the mean R1 latency (736 ms) was shorter than the mean R2 latency (753 ms) for the practice pairs but the difference was not significant. While 4 of the 8 stutterers showed an increase in mean latency from R1 to R2 of the practice pairs, 7 of the 8 showed an increase for the experimental pairs. Thus, while for the normals there was a switch both in direction and magnitude of the R1 - R2 differences between the practice and experimental pairs, for the stutterers the direction remained the same but the magnitude increased.

The obtained mean R1 latencies for stutterers are shorter than those for normals both for Block I and for Block II but in neither instance was the obtained $\underline{t}$ significant. While the obtained mean R2 latency for stutterers is shorter than that for normals in Block I the reverse is true in Block II. In neither case, however, is the difference between stutterers and normals significant. While the Blocks main effect in the analysis of variance in Table 6 (Block I mean R2 versus Block II mean R2) for the normals' latencies yields a nonsignificant F, an inspection of Table 5 and Figure 7 suggests a much longer mean R2 latency for Block II than for Block I for stutterers. A significant t ($P < .05$) was found for this difference for the stutterers.

An inspection of the mean response durations in Table 5 and in Figure 8 shows all differences between R1 and R2 and between R2+ and R2- to be very small. The small obtained differences together with the large interjudge differences in response duration measurements for many of the responses (see Table 1) resulted in the decision not to perform statistical tests on the response duration measurements. Though not tested for significance, the stutterers in this study had shorter mean response durations than the normals, and for both normals and stutterers the mean response durations increased from Block I to Block II.

Discussion

It has been observed (39, 75) that an inverse linear relationship exists for adults between object-naming latency and logarithm_{10} frequency of occurrence of names in the language. The findings of the present study suggest a similar relationship for children. This relationship seems evident for children whether the comparisons involve means or medians, adult or juvenile norms, or complete or adjusted word lists. Although the relationship is similar in direction for children and adults, the correlations obtained in this study for children are not as high as those reported by Wingfield (75) for adults. Wingfield, using two groups

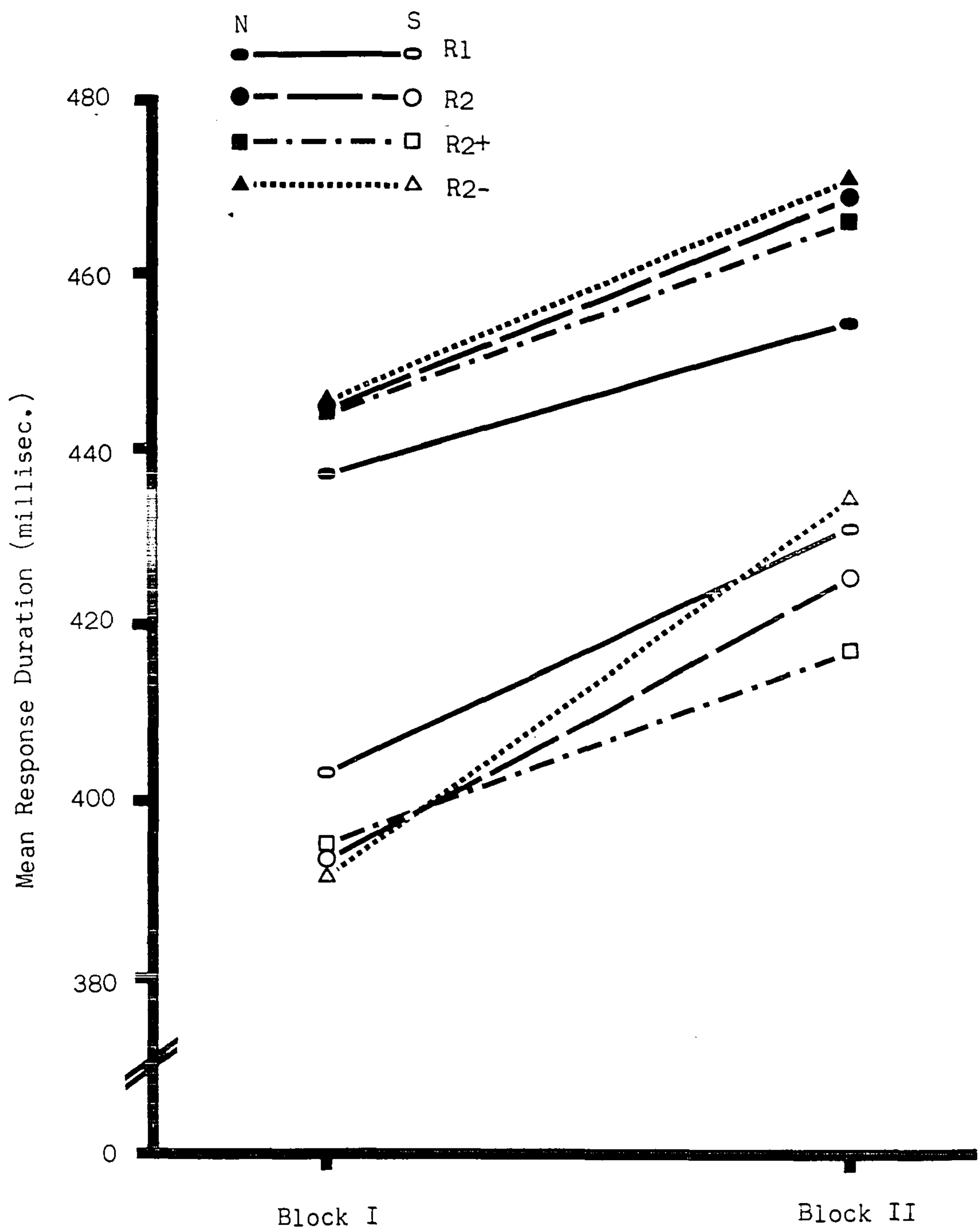


Figure 8. Mean response durations (in milliseconds) for R1, R2, R2+ and R2- for Block I (Pairs 1-12) and Block II (Pairs 13-24), for normals (N) and stutterers (S).

of adult subjects, the T-L norms, and 13 words covering a range in frequency similar to that used in the current study, obtained r's of -0.92 and -0.82. Fraisse (21), using words covering a wide range of frequencies according to the French norms presented by Gougenheim et al., (26), obtained a Spearman rank-order correlation coefficient for frequency and verbal reaction time of -0.49. Fraisse (22), using a list of words all of which were fairly rare in the French language, that is, words with a limited range of frequency, obtained a Spearman coefficient of -0.10 between frequency and verbal reaction time. Since the strength of the correlation between verbal reaction time and frequency seems to depend on the range of frequencies for the word used and since it is not clear how closely the range of frequencies for the French words used by Fraisse (21) compares to the range of frequencies used in the present study or in the Wingfield study, it is difficult to compare the correlation coefficients obtained in the latter studies with the -0.49 obtained by Fraisse.

The weaker relationship between latency and $\log_{10}$ frequency for children than for adults could be due to one or more of several factors. First, Oldfield (38) states that despite the criticisms that one might make of the use of the T-L Word Count, reasonable clearcut relationships emerge in terms of the logarithms of the values it provides for adults. The use of the T-L norms, however, may not be as appropriate today for children as they are for adults. Another explanation may lie in the greater variation among the object-naming latencies for children than for adults. A comparison of the standard deviations for the individual words, as reported in Table 2 in the present study for children, with the standard deviations reported by Oldfield and Wingfield (39) for adults, suggests much greater variation among children than among adults for object-naming latencies. This is consistent with the finding that variation in reaction time for simple motor behaviors tends to decrease with age from childhood to adulthood (78). The further comparison of the data in Table 2 in this study with the data provided by Oldfield and Wingfield demonstrates higher proportions of misnamed items for children than for adults. It might be that the pictures used in this study were more ambiguous for the juvenile subjects than those pictures used by Oldfield and Wingfield were for their adult subjects. For example, the stimulus picture for the word ball in the present study elicited the name "baseball" from almost as many normal subjects as it did the desired name "ball."

Much of the recent interest in the relation of object-naming and word frequency has resulted from efforts to arrive at a model for a vocabulary storage and retrieval system. Oldfield (38), for example, suggests a two-stage system, the first stage of which "consists in allotting the object to its correct frequency range, by some means which does not involve any actual identification and naming. The second stage consists of a binary search of the ensemble of words belonging to this range." Whatever the system may be, the findings of the present study suggest that the system for children may be similar to that for adults.

Interest in the object-naming task is also due in part to the fact that dysphasic patients have frequently been observed to have more difficulty in single object-naming than in producing the same word in context (39). Oldfield and Wingfield (40) have pointed out that in language disorders associated with brain-damage there may be difficulty in object-naming even when language functions appear otherwise intact. Oldfield (38) reports an inverse linear object-naming latency - log frequency relationship for adult brain-damaged patients and hospital controls similar to that found for normal adults. In fact, he found that the latency measurement could discriminate four groups of patients: hospital controls, patients with left cerebral hemisphere involvement with dysphasia, left with no dysphasia, and right with no dysphasia. It was found that dysphasics had the highest mean latency and the largest slope of the latency-log frequency linear regression line with the controls showing the lowest mean latency and the least slope.

The question might be raised as to whether or not stuttering children might have more word-finding difficulty than normal-speaking children. In fact, Rutherford and Telser (44) described a word latency test for use in detecting minimal word-finding problems in stutterers and in children with certain auditory and visual perceptual disorders. While in the present study the relationship between latency and log frequency was stronger for stutterers than for normals, the mean latencies for stutterers tended to be shorter than the mean latencies for normals. This would seem to suggest that stutterers, at least those of the age range used in this study, may have no more word-finding difficulty on the average than normal-speaking children of the same age.

Several investigators (53, 54, 65, 73) have reported more stuttering on low-frequency and long words than on high-frequency and short words. While low-frequency words also tend to be longer than high-frequency words, it has been suggested that word length and word frequency are independently related to frequency of stuttering (54, 65). It might be expected that with word frequency or word length controlled, words more likely to be stuttered along the uncontrolled dimension might have longer latencies than those which are less likely to be stuttered. Thus, if stuttering tends to occur on less frequent words and if latency is greater for words on which stuttering tends to occur, then longer latencies might be expected for stutterers on less frequent words. It might be predicted then that the line of regression of object-naming latency on log frequency of occurrence of the words would have a somewhat higher slope for stutterers than for normals. The regression lines obtained in this study for stutterers do in fact have slightly greater slopes than the corresponding lines for the normals. The steeper slopes for the stutterers than for the normals might be explained not on the basis of more word-finding difficulty for the stutterers, but rather on the basis of some other factor related to word frequency and/or word length. Wingate (73), for example, indicated that the greater stuttering for the less frequent and longer words might be due to more involved motor planning being required in order to articulate the words. While Oldfield and Wingfield (39) found for normal-speaking adults that longer latencies for less frequent words was not due to greater word length than common words, this does not rule out the possibility of this relationship existing for stutterers.

The procedures used in this study did not result in a differential effect of reward and nonreward on the object-naming latencies and response durations of either the normal-speaking or the stuttering children. The apparent, though nonsignificant, interaction between the latencies following reward and nonreward and Blocks I and II for the normal-speaking subjects does correspond somewhat to the crossover effect reported by Ryan (46) for nonverbal starting speeds. Ryan suggested that a motivational increment due to frustration occurred after the early nonrewarded responses. It is possible, for the task used in the present study, that more than 24 pairs are necessary to attain a significant difference between the latencies for responses following reward and those following nonreward and that further blocking of the trials would facilitate the observation of this effect.

The blocking of the paired responses of the stutterers into two blocks of 12 pairs each resulted in quite a different configuration for the R2 responses than was seen for the normal-speaking subjects. Instead of the relatively flat R2 curve and the crossover effect of R2+ and R2- observed for the normals, there is essentially no interaction for the R2+ and R2- means for the stutterers with the R2 means showing a significant increase from Block I to Block II. This trend for the stutterers for R2 to increase from the first to the last 12 trials deviates not only from the results observed for the normals but also from the findings of the various studies of nonverbal reaction time behavior. However, similarity is noted with findings from studies by Ford (20) and Endsley (17) which revealed increases in latency following failure as compared with success on R1 responses. In comparing their findings for nonreward with those of Endsley and Ford for failure, Ryan and Watson (51) suggest that nonreward, compared to social failure, may produce qualitatively different kinds of responses. They suggest that failure on R1, in addition to raising drive level, may elicit more interfering tendencies than is the case for nonreward. They note that if habit strength of one or more competing tendencies is stronger than habit strength of the R2 response, then an increase in drive after a frustrating event would result in a decrement in R2 performance.

One possible explanation for the marked increase in R2 latencies of the stutterers from first-to-last 12 trials is that they may have interpreted nonreward following their R1 responses as personal failure in naming R1. In reviewing studies by Sheehan and Zelen (59, 60) and Mast (37), Bloodstein (6) concludes that

> stutterers have appeared to be less inclined than nonstutterers to attempt what they were not sure they could do. Their attitudes, in short, have tended to be somewhat overly cautious or 'defeatist.' Presumably, the stutterers were more inclined to defend themselves against the threat of failure and in so doing tended to reveal a certain measure of insecurity.

This failure interpretation, if present, could have resulted in interfering tendencies to a rapid R2 response. What remains unexplained, however, is the fact that no differences between R2 response latencies following reward or nonreward were found. It is possible that the sense of failure generalized to all R2 responses even though measures were taken to minimize this by pairing reward with a red light and nonreward with a white light and by randomizing the order of picture-stimulus presentations.

Certain other experimental variables may have been active, resulting in the lack of findings of statistically significant differential effects of reward and nonreward on object-naming latency for R2 with both normals and stutterers. Studies of children involving nonverbal latency and response duration measurements have used homogeneous stimuli and responses. Compared to the simple reaction time behavior of repeatedly seeing a light and pulling a lever which was used by Ryan and his colleagues (46, 48), the present study examined disjunctive reaction time behavior in which one of three possible stimuli and their corresponding responses were possible. Woodworth and Schlosberg (78) note that disjunctive reactions can take from 20 to 200 milliseconds longer than for simple reactions. They indicate that the total possible number of motor responses (in this case three) are held in readiness, but none of them can be allowed to reach "hair trigger" readiness if false reactions are to be avoided. Perhaps the use of different stimuli and thus different responses in this investigation introduced variability which may have helped obscure any differences between effects of nonreward and reward.

Such variability, however, may have been the product of influences other than those attributable to disjunctive factors since each subject had received a series of practice trials with the stimuli used for the experimental trials and might be expected to have been equally familiar with each. Referring to simple reaction time behavior, Woodworth and Schlosberg (78) stress that aside from differences between individuals, the same individual varies in his reaction time from day to day and moment to moment. They note that at the psychological level certain variable factors can be discerned. The subject's attention may wander; a fleeting emotion may disturb his adjustment to the task; his sense organs may vary in sensitivity; his set may shift more or less to the sensory or motor side; his muscles may oscillate in their readiness for action. Concerning the speech responses of the present investigation, factors influencing latency and the measurement of latency include the following: inhalation and exhalation of varying durations prior to the naming response; swallowing behavior; subvocalizations, and oral sounds associated with tongue, palate and lip contact or release; and variable postures of the articulators prior to the naming response. Jensen (31), who found no differential effect of reward or punishment on latency for repeating aurally presented nonsense words for children, also reported highly variable latencies and response durations.

Another subject variable concerns chronological age, and reaction to nonreward. From their review of the literature, Ryan and Watson (50) conclude that cognitive factors may be more influential in reaction to nonreward with corresponding increases in age. They consider it possible that older subjects react to nonreward by engaging in various problem-solving strategies rather than simply increasing vigor of performance. In the present investigation, it appeared that some of the subjects might have been trying to figure out the reward contingency by alternately speeding up and slowing down their responses. Efforts to solve the reward contingency were extended to other aspects of the experimental procedure, as evidenced by one subject's comment indicating that he felt he was getting only one marble because he had only put in one puzzle piece during the inter-pair interval. This tendency to change responses following nonreward has been referred to by Ryan and Watson as a negative recency effect, a problem-solving strategy which possibly obscures a frustration effect. It seems reasonable, then, that the discrepant findings regarding frustration effect for nonverbal lever-pulling behavior and verbal object-naming behavior could, in part, be attributed to differences in age and the corresponding differences in reaction to nonreward.

Marshall (34) observed that the token reward (candy) in his study was dispensed into a plastic container which the child could see but not grasp. He speculated that frustration could have developed in not being able to grasp the reward immediately. Semler and Pederson (55) dispensed the token reward into a cup which the subject could collect after each response, giving him time, then, to place the marble in a marble board. In the present study, the child could feel the marble reward drop into his hand following each response. Such a sensation was followed only three-to-five seconds later by presentation of the second stimulus picture. Although this method was adopted to magnify the difference in sensation between nonreward and reward, and to avoid any momentary frustration when reward was indicated, it may have served as a distracting influence on the initiation of the R2 response.

The importance of the inter-pair interval has been stressed (46) as a time for dissipation of any frustration experienced following the previous paired responses. Although a twenty-four hour period was reported by Amsel (1) with the use of rats, Ryan (46) indicated that massed trials with as little as forty-five seconds could be effective, if the intra-pair interval was no more than five-to-ten seconds. Interpretation of his procedures, however, suggests that the child was kept busy with activities in the absence of examiner interaction. The use of examiner interaction during the inter-pair interval in the present investigation may have gone beyond the intent of dissipating frustration to the extent of providing a reassuring atmosphere that all would come out well for the child. Few children appeared overtly upset or anxious about winning the prize, as nonrewards were administered. It is also possible that a longer interval than forty-five seconds would have been more effective in the present study.

The apparent trend for R2 to become longer than R1 when the possibility of rewards was introduced into the experimental condition as compared to the opposite trend for the responses in Paired-Picture Practice Condition A, might be interpreted as suggesting that frustrative nonreward for an object-naming task may actually result in increased R2 latencies. This might not have been expected in view of the studies which have found decreased R2 starting speeds for simple motor tasks. The motor behavior of pulling a lever would appear, however, to be a much more simple task, involving less neuromuscular coordination or cognitive activity, than object-naming. Frustration, being a negative emotion, may well result in a much greater disorganization of speech behavior than of a simple motor behavior such as lever pulling (11, 28). This disorganization could result in longer latencies and response durations. Thus, while frustrative nonreward has been shown to result in faster starting and movement speeds for simple motor responses, the opposite may be true for more complicated disjunctive reactions.

CHAPTER V

SUMMARY

This study explored the effects of nonreward on the object-naming latencies and response durations of children. Twenty normal-speaking and eight stuttering males provided naming responses to twenty-four randomized pairs of simple-object line-drawn pictures, where the first responses of the pairs were rewarded on a 50 per cent schedule and the second responses on a 100 per cent schedule. The stimuli consisted of pictures of boy, bed and bear. The randomization schedules for the pairs of pictures differed from subject to subject. Latency and response duration measurements were made.

This experimental task was preceded by the presentation of a series of thirty-four simple-object pictures, selected to represent a range from highest to lowest frequency of occurrence in the English language. While this task familiarized each child with a naming task having a stimulus-response set similar to the experimental task, it also provided data for determining the relationship between object-naming latency and frequency of occurrence of words in the language.

The main findings of this study were:

1. The time taken by children, normal-speaking and stuttering, to name objects is negatively correlated with the logarithm_{10} of the

frequency of occurrence of the names in the language.

2. For the total (24 pairs) experimental paired naming task condition, mean R2 latency tended to be greater than mean R1 latency, the difference being significant for the stutterers but not for the normals.

3. For the total (24 pairs) experimental paired naming task condition, whether or not R2 follows reward (R2+) or nonreward (R2-) of R1 appeared to have no differential effect on the mean R2 latency.

4. When the 24 pairs of the experimental paired naming task condition are divided into 2 blocks of 12 pairs each the following was found:

a. For the normal-speaking children, an apparent crossover effect occurred with R2- greater than R2+ for the first 12 pairs (Block I) and less than R2+ for the last 12 pairs (Block II). The interaction was not statistically significant, however. Mean R2 showed little change from Block I to Block II.

b. For the stuttering children, the difference between R2+ and R2- was very small in both Block I and Block II, with mean R2, however, showing a significant lengthening from Block I to Block II.

5. No evidence was found in this study to indicate that stuttering children have longer object-naming latencies than non-stuttering children.

6. All differences in mean response duration between R1 and R2 and between R2+ and R2- were very small for both normal-speaking children and for stuttering children.

BIBLIOGRAPHY

1. Amsel, A. The role of frustrative nonreward in noncontinuous reward situations. Psychol. Bull., 1958, 55, 102-119.

2. Amsel, A., and Hancock, W. Motivational properties of frustration: III. Relation of frustration effect to antedating goal factors. J. Exper. Psychol., 1957, 53, 126-131.

3. Amsel, A., and Roussel, J. Motivational properties of frustration: I. Effect on a running response of the addition of frustration to the motivational complex. J. Exper. Psychol., 1952, 43, 363-368.

4. Amsel, A., and Ward, J. Motivational properties of frustration: II. Frustration drive stimulus and frustration reduction in selective learning. J. Exper. Psychol., 1954, 48, 37-47.

5. Baumeister, A., and Kellas, G. Refractoriness in the reaction times of normals and retardates as a function of response-stimulus interval. J. Exper. Psychol., 1967, 75, 122-125.

6. Bloodstein, O. A Handbook on Stuttering. Chicago: National Easter Seal Society, 1969.

7. Brookshire, R., and Martin, R. The differential effects of three verbal punishers on the disfluencies of normal speakers. J. Speech Hear. Res., 1967, 10, 496-505.

8. Brookshire, R., and Eveslage, R. Verbal punishment of disfluency following augmentation of disfluency by random delivery of aversive stimuli. J. Speech Hear. Res., 1969, 12, 383-388.

9. Brookshire, R. Effects of random and response contingent noise upon disfluencies of normal speakers. J. Speech Hear. Res., 1969, 12, 126-134.

10. Bruning, J. Effects of magnitude of reward and percentage of reinforcement on a lever movement response. Child Develop., 1964, 35, 281-285.

11. Brutten, E., and Shoemaker, D. The Modification of Stuttering. Englewood Cliffs, N. J.: Prentice-Hall, 1967.

12. Cantor, G., and Ryan, T. Response speed related to reinforcement schedule: Report of errata and additional analyses. Child Develop., 1964, 35, 999-1002.

13. Daly, D., and Cooper, E. Rate of stuttering adaptation under two electro-shock conditions. Behav. Res. Therapy, 1967, 5, 49-54.

14. Davis, Dorothy. The relation of repetitions in the speech of young children to certain measures of language maturity and situational factors, Part I. J. Speech Dis., 1939, 4, 303-318.

15. Davis, Dorothy. The relation of repetitions in the speech of young children to certain measures of language and maturity and situational factors, Part II and Part III. J. Speech Dis., 1940, 5, 235-246.

16. Dunn, L. Peabody Picture Vocabulary Test. Minneapolis, Minn.: American Guidance Service, Inc., 1959.

17. Endsley, R. Effortfulness and blocking at different distances from the goal as determinants of response speed and amplitude. J. Exper. Child Psychol., 1966, 3, 18-30.

18. Flanagan, B., Goldiamond, I., and Azrin, N. Instatement of stuttering in normally fluent individuals through operant procedures. Science, 1959, 130, 979-981.

19. Flanagan, B., Goldiamond, I., and Azrin, N. Operant stuttering: The control of stuttering behavior through response-contingent consequences. J. Exper. Anal. Behav., 1958, 1, 173-177.

20. Ford, L. Reaction to failure as a function of expectancy for success. J. abnorm. soc. Psychol., 1963, 67, 340-348.

21. Fraisse, P. La perception des mots. In Problems de Psycho-Linguistique. Paris: Presses Universitaires de France, 1963.

22. Fraisse, P. Le temps de reaction verbale. I. Denomination et lecture. Annee Psychol., 1964, 64, 21-46.

23. Fraisse, P. Relations entre le seuil de reconnaissance perceptive et le temps de reaction verbale. Psychol. Franc., 1964, 9, 77-85.

24. Fraisse, P., Lanati, L., Regnier, J., and Wahl, M. Le temps de reaction verbale. II. Responses specifiques et categorielles. Annee Psychol., 1965, 65, 27-32.

25. Garrett, H. Great Experiments in Psychology. New York: Appleton-Century-Crofts, 1951.

26. Gougenheim, G., Michea, R., Rivenc, P., and Sauvageot, A. L'elaboration du francais elementaire et d'une grammaire de base. Paris: Didier, 1956.

27. Haroldson, S., Martin, R., and Starr, C. Time-out as a punishment for stuttering. J. Speech Hear. Res., 1968, 11, 560-566.

28. Hill, H. An experimental study of disorganization of speech and manual responses in normal subjects. J. Speech Hear. Res., 1954, 19, 295-305.

29. Holton, Ruth. Amplitude of an instrumental response following the cessation of reward. Child Develop., 1961, 32, 107-116.

30. Ideal Picture Cards. Ideal School Supply Company, Oak Lawn, Illinois.

31. Jensen, P. Effects of reward and punishment on stuttering in children. Project No. 5-8377, Cooperative Research Program, Office of Education, U.S. Department of Health, Education and Welfare, 1966.

32. Johnson, W., Brown, S., Curtis, J., Edney, C., and Keaster, J. Speech Handicapped School Children. New York: Harper and Bros., Rev. Ed., 1956.

33. Karlin, L., and Mordkoff, A. Decreased reaction time produced by discordant warning and reaction stimuli. Psycho. Sci., 1967, 9, 555-556.

34. Marshall, R. An exploratory investigation of the effects of reward schedule changes on children's speech fluency. Ph.D. Dissertation. University of Oklahoma, 1969.

35. Martin, R., and Siegel, G. The effects of response contingent shock on stuttering. J. Speech Hear. Res., 1966, 9, 340-352.

36. Martin, R., and Siegel, G. The effects of simultaneously punishing stuttering and rewarding fluency. J. Speech Hear. Res., 1966, 9, 466-475.

37. Mast, V. Level of aspiration as a method of studying the personality of adult stutterers. Speech Monogr., 1952, 19, 196. Abstract.

38. Oldfield, R. Things, words, and the brain. Quart. J. exper. psychol., 1966, 18, 340-353.

39. Oldfield, R., and Wingfield, A. Response latencies in naming objects. Quart. J. Exper. Psychol., 1965, 17, 273-281.

40. Oldfield, R., and Wingfield, A. The time it takes to name an object. Nature, 1964, 202, 1031-1032.

41. Penny, R. The effects of non-reinforcement on response strength as a function of number of previous reinforcements. Canad. J. Psychol., 1960, 14, 206-215.

42. Quist, R., and Martin, R. The effect of response contingent verbal punishment on stuttering. J. Speech Hear. Res., 1967, 10, 795-800.

43. Roussel, J. Frustration effect as a function of repeated non-reinforcements and as a function of the consistency of reinforcement prior to the introduction of non-reinforcement. Unpublished Master's thesis, Tulane Univ., 1952.

44. Rutherford, D., and Telser, E. Word-finding abilities of kindergarten and first-grade children. Program of the 43rd Annual Convention of the American Speech and Hearing Association, 1967, p. 72, Abstract.

45. Ryan, T. Instrumental performance as related to several reward schedules and age. J. Exper. Child Psychol., 1966, 3, 398-404.

46. Ryan, T. The effects of non-reinforcement and incentive value on response speed. Child Develop., 1965, 36, 1067-1081.

47. Ryan, T., and Cantor, G. Response speed in children as a function of reinforcement schedule. Child Develop., 1962, 33, 871-878.

48. Ryan, T., and Moffitt, A. Response speed as a function of age, incentive value, and reinforcement schedule. Child Develop., 1966, 37, 103-113.

49. Ryan, T., and Voorhoeve, A. A parametric investigation of reinforcement schedule and sex of S as related to acquisition and extinction of an instrumental response. J. Exper. Child Psychol., 1966, 4, 189-197.

50. Ryan, T., and Watson, P. Children's response speeds as a function of sex and verbal reinforcement schedule. Psychon. Sci., 1966, 6, 271-272.

51. Ryan, T., and Watson, P. Frustrative nonreward theory applied to children's behavior. Psych. Bull., 1968, 69, 111-125.

52. Savoye, A. The effect of the Skinner-Estes operant conditioning punishment paradigm upon the production of nonfluencies in normal speakers. M. S. Thesis, Univ. of Pittsburgh, 1959.

53. Schlesinger, I., Forte, M., Fried, B., and Melkman, R. Stuttering, information load, and response strength. J. Speech Hear. Dis., 1965, 30, 32-36.

54. Schlesinger, I., Melkman, R., and Levy, R. Word length and frequency as determinants of stuttering. Psychon. Sci., 1966, 6, 255-256.

55. Semler, I., and Pederson, D. Children's reactions to nonreward: Partial vs. continuous reinforcement using a within-subjects design. Psychon. Sci., 1968, 10, 285-286.

56. Shames, G., and Sherrick, C. A discussion of nonfluency and stuttering as operant behavior. J. Speech Hear. Dis., 1963, 28, 3-18.

57. Sheehan, J. The modification of stuttering through non-reinforcement. J. Abnorm. Soc. Psychol., 1951, 46, 51-63.

58. Sheehan, J. Theory and treatment of stuttering as an approach-avoidance conflict. J. Psychol., 1953, 36, 27-49.

59. Sheehan, J., and Zelen, S. A level of aspiration study of stutterers. Amer. Psychol., 1951, 6, 500. Abstract.

60. Sheehan, J., and Zelen, S. Level of aspiration in stutterers and nonstutterers. J. abnorm. soc. Psychol., 1955, 51, 83-86.

61. Siegel, G., and Martin, R. Experimental modification of disfluency in normal speakers. J. Speech Hear. Res., 1965, 8, 235-244.

62. Siegel, G., and Martin, R. Punishment of disfluencies in normal speakers. J. Speech Hear. Res., 1966, 9, 208-218.

63. Siegel, G., and Martin, R. Verbal punishment of disfluencies in normal speakers. J. Speech Hear. Res., 1965, 8, 245-251.

64. Skinner, B. Are theories of learning necessary? Psychol. Rev., 1950, 57, 193-216.

65. Soderberg, G. The relations of stuttering to word length and word frequency. J. Speech Hear. Res., 1966, 9, 584-589.

66. Stassi, E. Disfluency of normal speakers and reinforcement. J. Speech Hear. Res., 1961, 4, 358-361.

67. Teichner, W. Recent studies of simple reaction time. Psychol. Bull., 1954, 51, 128-149.

68. Thorndike, E., and Lorge, I. The Teachers' Word Book of 30,000 Words. New York: Columbia University, 1944.

69. Van Riper, C. Speech Correction: Principles and Methods. Englewood Cliffs, N. J.: Prentice Hall, 4th ed., 1964.

70. Van Riper, C. The effect of penalty upon frequency of stuttering spasms. J. Genet. Psychol., 1937, 50, 193-195.

71. Watson, P. Response measure effects in children as a function of type and schedule of reward. Psychon. Sci., 1968, 13, 217-218.

72. Watson, P., and Ryan, T. Duration of the frustration effect in children. J. Exper. Child Psychol., 1966, 4, 242-247.

73. Wingate, M. Stuttering and word length. J. Speech Hear. Res., 1967, 10, 146-152.

74. Wingfield, A. Effects of frequency on identification and naming of objects. Amer. J. Psychol., 81, 1968, 226-234.

75. Wingfield, A. Perceptual and response hierachies in object identification. Acta Psychologica, 1967, 26, 216-226.

76. Wischner, G. An experimental approach to expectancy and anxiety in stuttering behavior. J. Speech Hear. Dis., 1952, 17, 139-154.

77. Wischner, G. Stuttering behavior and learning: a preliminary theoretical formulation. J. Speech Hear. Dis., 1950, 15, 324-335.

78. Woodworth, R., and Schlosberg, H. Experimental Psychology. New York: Holt, Rinehart and Winston, 1954.

APPENDIX A

SAMPLE RANDOMIZED SCHEDULES FOR THE FOUR CONDITIONS

SAMPLE RANDOMIZED SCHEDULES FOR THE FOUR CONDITIONS

PRACTICE ITEMS

mop

tiger

SINGLE-PICTURE PRACTICE CONDITION

1. bee	18. feather
2. rooster	19. screw
3. bed	20. turtle
4. gum	21. boy
5. drum	22. toaster
6. bear	23. magnet
7. nail	24. ring
8. carrot	25. zebra
9. pear	26. screwdriver
10. bell	27. man
11. violin	28. broom
12. mitten	29. doll
13. pumpkin	30. ball
14. ladder	31. paintbrush
15. camel	32. garage
16. deer	33. door
17. rake	34. dog

PAIRED-PICTURE PRACTICE CONDITIONS

A	B
C A	C r A
B C	B r C
B A	A r B
A B	B n A
C B	
A C	

EXPERIMENTAL CONDITION

1. C r A	13. B r A
2. B n A	14. A n B
3. C n B	15. B n C
4. A r B	16. C r A
5. C r B	17. A r C
6. B n C	18. C n A
7. A n B	19. A r B
8. B r C	20. A n C
9. C n A	21. B r C
10. A r C	22. C n B
11. B r A	23. B n A
12. A n C	24. C r B

A = boy, B = bed, C = bear, r = R1 rewarded, n = R1 nonrewarded, with R2 always rewarded.

APPENDIX B

INSTRUCTIONS TO SUBJECTS

INSTRUCTIONS TO SUBJECTS

Single-Picture Practice Condition

This is a picture-viewing box. Put your face up to the window and you will see a small screen in front of you. Watch closely now as a picture comes on the screen. What do you see?..... That's right...mop. You named the picture correctly by saying mop-not a mop or the mop-just one word... mop. Now you will see another picture. What do you see now? .... Now, you will see a number of different pictures on the screen. I want you to name each picture as it comes on the screen just as quickly as you can. Before each picture comes on the screen, I will say "Ready". When I say "Ready", do not answer me. Just make sure your eyes are on the screen so that you will be able to name the picture just as quickly as you can. Any questions?........ Are you all set?..... Let's begin.

Paired-Picture Practice Condition A

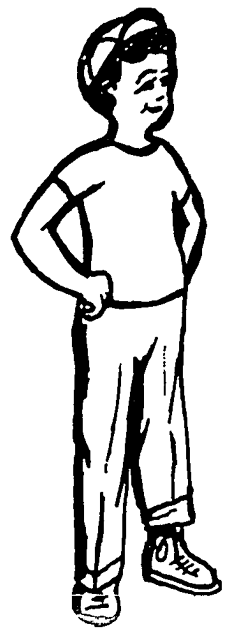
Now, you will be seeing just a few of the pictures which you have already seen- boy, bed, and bear. You will see two pictures on the screen, one almost immediately after the other. You will then have a short rest while the picture-viewer reloads before the next two pictures are shown. Any questions? Remember, it's important to name each picture just as quickly as you see it on the screen. When I say "Ready", make sure your eyes are on the screen. Are you all set? Let's continue.

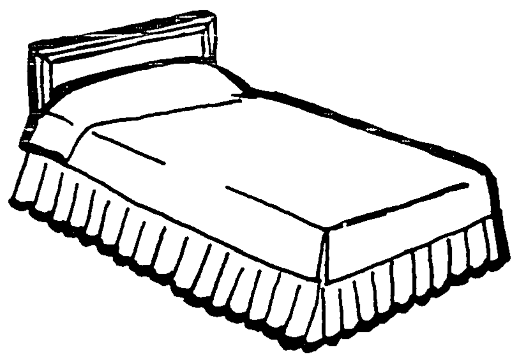
Paired-Picture Practice Condition B
Experimental Condition

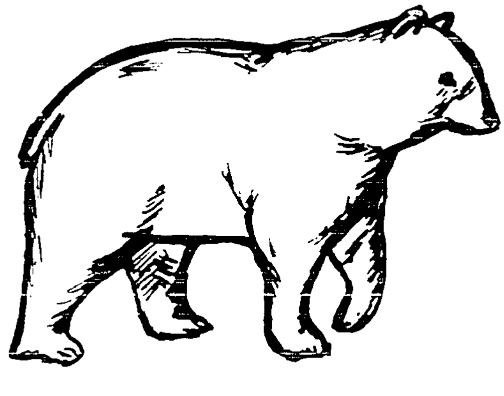
Now you will be able to use the picture-viewer to win a prize! Here's how it works: When you see a picture come on the screen and you name it, a marble is dropped down a tube inside the box. You can feel the end of the tube by putting your hand through this opening. Can you feel it? I'll show you how it works in just a minute. The object of the game is to collect as many marbles as you can in this cup. If you can collect enough marbles, you will win a prize. The prize which you are playing to win is in this sack. The picture-viewer will show the pictures which you have just seen on the screen - <u>boy</u>, <u>bed</u>, and <u>bear</u>. Just as before, you will see two pictures, one almost immediately after the other. You will then have a short rest before the next two pictures are shown. Before the pictures come on, I will say "Ready". When I say "Ready", make sure your eyes are on the screen so that you can name the picture just as soon as it comes on. Hold your hand around the bottom of the tube so that you can catch the marble which drops down. Keep your hand around the end of the tube and your eyes on the screen until you have seen <u>both</u> pictures. After you have seen <u>both</u> pictures, put your marbles in this cup. While we are waiting for the picture-viewer to reload between pairs of pictures, we'll have several puzzles here which we can put together. When the picture-viewer is ready again, you will be able to name two more pictures and collect two more marbles. As soon as the picture-viewer runs out of pictures, the game will be over. Now, let's try it out. Put your face up to the window and your hand around the end of the tube. When the picture comes on, name it just as you have been doing. "Ready"?

APPENDIX C

EXPERIMENTAL PICTURE STIMULI







APPENDIX D

MEAN OBJECT-NAMING LATENCY AND RESPONSE DURATION MEASURES FOR THE EXPERIMENTAL CONDITION

TABLE 7

MEAN OBJECT-NAMING LATENCIES AND RESPONSE DURATIONS FOR 100 PER CENT (R1), 50 PER CENT (R2) WITH REWARD AND NONREWARD COMBINED, REWARD (R2+), AND NONREWARD (R2-), FOR NORMALS (N=20) AND STUTTERERS (N=8)

Subjects	Mean Object-Naming Latency				Mean Response Duration			
	R1	R2	R2+	R2-	R1	R2	R2+	R2-
Normals								
1	683	668	725	612	346	354	356	351
2	848	693	698	688	412	425	444	405
3	653	721	688	754	414	419	408	429
4	440	527	536	517	341	307	314	300
5	737	761	833	689	433	443	455	431
6	846	909	943	875	372	405	421	390
7	791	663	669	657	365	377	370	384
8	804	864	800	928	549	587	560	614
9	597	749	773	725	396	436	451	422
10	720	750	734	766	364	389	397	380
11	725	954	953	955	406	373	373	372
12	818	757	711	803	700	731	730	732
13	649	663	663	663	406	383	409	356
14	790	702	730	673	325	345	337	354
15	730	687	715	659	449	484	491	476
16	762	914	973	854	621	617	591	642
17	743	831	724	939	378	369	383	354
18	706	753	845	662	423	421	423	418

TABLE 7--Continued

Subjects	Mean Object-Naming Latency				Mean Response Duration			
	R1	R2	R2+	R2-	R1	R2	R2+	R2-
Normals								
19	603	800	718	882	550	551	544	558
20	765	693	699	688	655	659	649	669
Stutterers								
1	681	669	660	677	373	407	404	410
2	832	861	852	870	427	425	414	437
3	747	947	820	1074	482	466	496	436
4	510	561	592	530	386	353	359	347
5	706	886	914	857	375	339	335	343
6	661	825	810	839	322	327	295	360
7	573	686	779	593	554	561	553	569
8	409	444	436	452	446	396	396	396

APPENDIX E

OBJECT-NAMING LATENCY MEASURES FOR THE SINGLE-PICTURE PRACTICE CONDITION

TABLE 8

OBJECT-NAMING LATENCIES FOR THE 34 ITEMS IN THE SINGLE-PICTURE PRACTICE CONDITION FOR 20 NORMAL SUBJECTS

	Subjects									
Words	1	2	3	4	5	6	7	8	9	10
1	1025	1410	1130	965	1080	1165	925	1560	850	920
2	1255	1195	985	760	775	905	910	885	875	1185
3	1590	1425	1070	1030	880	1080	905	1490	795	1110
4	955	1500	1075	785	800	835	840	875	840	1090
5	1375	1310	1840	1330	a	1135	955	805	a	1845
6	a	960	a	910	a	940	840	1135	710	a
7	1110	915	1285	1520	940	1240	1085	840	750	995
8	1110	930	1595	1125	1460	1150	930	880	775	1075
9	1080	1520	1050	1145	830	a	1060	885	1080	1030
10	1490	965	1125	1225	720	955	1175	880	870	875
11	1305	1430	980	815	720	1785	835	800	925	970
12	1290	1010	945	850	810	1715	985	995	1360	1490
13	a	1795	a	890	970	a	a	a	a	a
14	1090	860	925	2370	720	1880	900	1135	1760	1050
15	1030	900	1030	1300	930	1005	3250	1325	905	1715
16	a	2835	1080	a	1475	2175	1860	1535	a	2535
17	1420	1920	2000	a	1045	a	1180	a	a	1435

TABLE 8--Continued

Words	Subjects 1	2	3	4	5	6	7	8	9	10
18	1050	1790	1260	1150	1955	1330	805	835	940	1285
19	1255	1260	840	1005	1045	1440	7560	1045	820	1020
20	a	1585	1505	1275	1445	a	1455	1490	1600	2080
21	1000	1365	1020	1015	1025	a	1470	1360	980	a
22	1015	760	950	800	735	1105	1250	910	1000	890
23	4465	1490	1310	1460	820	1095	1175	4900	2400	995
24	1105	1605	1340	1870	1055	a	a	1330	1210	2360
25	1635	2510	1720	1745	1490	a	a	a	a	1560
26	a	a	1075	2325	a	a	1490	11195	885	a
27	1760	5710	1920	1730	3625	2310	a	7935	a	1510
28	1185	1435	1015	970	a	1135	1055	940	880	a
29	1260	1195	1025	860	1035	1075	1155	990	1730	830
30	1375	1470	1160	995	2500	1165	a	1320	1410	a
31	950	780	1505	805	835	950	1040	2365	1255	950
32	1175	1140	1560	1180	1175	1590	1240	3365	1220	1015
33	1100	a	2110	1265	1145	1050	995	1020	a	a
34	1470	1250	1155	1530	1650	1690	2520	1650	1535	1765

TABLE 8--Continued

Words	Subjects 11	12	13	14	15	16	17	18	19	20
1	1735	1090	965	2360	1160	960	1435	875	970	1210
2	1065	1190	1005	1240	980	970	970	1075	1180	1670
3	1690	1220	a	1215	1540	a	a	1580	1030	1460
4	1040	990	820	2305	770	1055	880	1035	860	1130
5	a	1640	885	1635	830	820	1020	a	1070	a
6	a	a	1115	a	a	480	a	1020	a	1365
7	1740	925	835	1690	925	1040	1150	a	945	1975
8	1095	1210	930	1395	1030	865	940	1160	870	1270
9	755	1090	920	1710	1385	1510	930	720	805	1360
10	985	945	855	1785	880	875	1475	1675	880	1015
11	785	775	1230	1105	885	735	910	655	695	1520
12	1110	1085	1025	875	1255	990	1165	1355	935	a
13	2530	a	880	1750	1225	a	1995	970	1055	1800
14	1100	1450	940	3230	990	780	1310	800	870	1130
15	1025	940	955	1860	845	1830	1750	925	a	1920
16	945	1620	1220	1920	1100	960	1130	1290	1125	1495
17	1550	2485	1135	1150	1140	a	1670	a	1430	3500

TABLE 8--Continued

	Subjects									
Words	11	12	13	14	15	16	17	18	19	20
18	1020	910	900	1295	960	905	1815	1000	835	1995
19	895	1165	900	1160	945	860	1190	1730	920	1280
20	1505	1460	1135	1800	1360	a	a	1265	1335	1780
21	1030	1035	1755	1430	1320	1105	2870	1260	2020	1860
22	1145	955	805	945	815	805	950	835	825	1265
23	930	780	a	2975	a	1280	a	1165	1470	1770
24	1530	1460	2870	1240	1850	880	a	a	4040	3460
25	a	a	a	a	1795	a	a	1270	840	a
26	1400	1500	1140	1880	a	a	1750	3010	1255	a
27	2905	1350	1470	4050	1530	1310	1915	1565	a	9955
28	a	a	1450	a	1450	1950	a	2455	930	1750
29	810	850	1250	990	930	830	830	1320	790	1180
30	1215	a	a	a	1100	1410	a	895	a	1840
31	790	1230	995	1650	755	1000	1230	1510	1815	1080
32	915	2550	1025	1300	1005	1045	995	920	1265	1480
33	1130	1895	a	2650	1185	1245	1450	1230	a	2290
34	1705	1785	1160	1665	1015	1665	1465	2010	1520	4145

[a]Misnamed words

TABLE 9

OBJECT-NAMING LATENCIES FOR THE 34 ITEMS IN THE SINGLE-PICTURE PRACTICE CONDITION FOR 8 STUTTERING SUBJECTS

	Subjects							
Words	1	2	3	4	5	6	7	8
1	1285	1155	1035	735	910	b	770	755
2	1010	1130	1060	660	915	1090	660	a
3	1120	3060	1090	870	1015	1250	960	1215
4	1030	1090	1390	650	825	970	720	840
5	a	a	a	1015	1210	1540	925	a
6	1345	1030	795	760	1025	870	a	a
7	1095	1450	1250	775	1265	b	780	1210
8	935	1320	920	850	1105	985	855	910
9	965	1150	2005	910	a	1025	805	1100
10	1070	1240	1610	860	1330	b	985	680
11	1200	1260	1540	710	770	860	780	715
12	a	1500	1465	a	920	1715	830	955
13	a	1810	a	a	1000	a	1070	1485
14	1160	930	1190	700	935	790	790	1100
15	1050	1600	1125	965	1000	1515	945	930
16	a	1480	a	690	1190	b	1630	1190
17	a	1465	1915	1305	1030	b	1050	1835

TABLE 9--Continued

	Subjects							
Words	1	2	3	4	5	6	7	8
18	1055	2385	1455	840	955	b	940	1610
19	1080	1265	1230	935	1215	1555	750	1215
20	a	1490	1245	a	1805	2030	1020	a
21	1600	1365	1935	1190	1460	b	1290	1485
22	1315	985	820	875	845	820	990	1650
23	2280	2200	985	995	1700	b	655	1140
24	1560	1860	1390	1880	1835	b	1775	1315
25	a	1210	a	1310	1410	a	1145	1590
26	2880	a	a	a	975	1590	2215	1065
27	a	1665	1625	1690	1255	2610	1535	a
28	1790	a	a	a	1145	1290	a	a
29	1080	920	1375	1040	6840	b	785	1320
30	1390	1215	a	780	1420	2055	a	a
31	1125	1065	770	840	880	1350	720	1000
32	1240	2400	1050	920	1210	2710	1010	970
33	1010	3030	a	a	1720	3275	1545	1065
34	1105	1900	a	1935	1085	b	1310	1660

[a]Misnamed words

[b]Values missing because of failure to activate recorder