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EFFECTS OF REWARD AND PUNISHMENT ON STUTTERING IN CHILDREN.

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THE STUDY WAS DESIGNED TO DETERMINE WHETHER OR NOT THERE ARE SIGNIFICANTLY GREATER LATENCY AND RESPONSE DURATIONS IN CHILDREN'S SPEECH AS A RESULT OF VERBAL PUNISHMENT COMPARED TO REWARD, AND WHETHER THE EFFECTS ARE GREATER IN YOUNGER OR OLDER CHILDREN AND IN BOYS OR GIRLS. SUBJECTS WERE 160 BOYS AND GIRLS FROM THIRD AND SIXTH GRADES. DURING A CONTROL PERIOD SUBJECTS REPEATED TRISYLLABLE NONSENSE WORDS PRODUCED BY A RECORDED VOICE. DURING THE DIFFERENTIAL TREATMENT PERIOD, SUBJECTS AGAIN REPEATED THE NONSENSE WORDS. GROUP A RECEIVED POSITIVE VERBAL REINFORCEMENT, AND GROUP B RECEIVED NEGATIVE VERBAL REINFORCEMENT. DEPENDENT VARIABLES WERE LATENCY DURATION (TIME FROM THE END OF AN AUDITORY STIMULUS TO THE BEGINNING OF SUBJECT'S RESPONSE) AND RESPONSE DURATION (TIME FROM BEGINNING TO END OF A SUBJECT'S RESPONSE). INDEPENDENT VARIABLES WERE PERIOD (CONTROL AND EFFORT), CONDITION (REWARD AND PUNISHMENT), GRADE (THIRD AND SIXTH), AND SEX (FEMALE AND MALE). ANALYSIS OF VARIANCE AND COVARIANCE WERE USED TO EVALUATE THE DATA AND REVEALED EVIDENCE OF HETEROGENEITY OF VARIANCE SO THAT FINDINGS MAY NOT BE ASSUMED TO BE RELATED ONLY TO TREATMENT LEVELS OR MEANS. CONCLUSIONS WERE (1) INTRINSIC CHARACTERISTICS EXISTING AMONG CHILDREN NEED TO BE ISOLATED FOR MAXIMUM UNDERSTANDING OF DISFLUENCY, (2) THE GENERAL TENDENCY IN THE LITERATURE TO INTERPRET ADULT FINDINGS AS APPLICABLE TO CHILDREN MAY BE UNWARRANTED, (3) LATENCY APPEARS UNRELATED TO REWARD AND PUNISHMENT FOR BOYS AND GIRLS IN THIRD AND SIXTH GRADES, (4) THIRD GRADE CHILDREN HAVE MORE DISFLUENCY (AS MEASURED BY RESPONSE DURATION) THAN SIXTH GRADE CHILDREN IN THIS SITUATION, BUT NOT NECESSARILY AS A RESULT OF PUNISHMENT, (5) GENERALLY, VERBAL PUNISHMENT WAS ASSOCIATED WITH LONGER UTTERANCE THAN VERBAL REWARD, AND (6) GIRLS HAD SHORTER RESPONSES WHEN REWARDED AND LONGER RESPONSES WHEN PUNISHED AS COMPARED TO MALES WHO SHOWED NO DIFFERENCE BETWEEN CONDITIONS. A REFERENCE LIST CITES 25 ITEMS. (MY)

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ON STUTTERING IN CHILDREN

Cooperative Research Project No. 5-8377 (S-443)

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Communication Sciences Laboratory
University of Florida
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION AND STATEMENT OF PURPOSE

Introduction

More or less characteristic of the speech of all children (as well as adults) are disfluencies which tend to interrupt the flow of speech. More specifically, they may be observed as (1) repeated sounds, syllables, words, and phrases which do not change the meaning of the item of expression on which the repetition occurs, (2) non-phonemically prolonged phonetic elements, (3) non-semantic interjected vocalizations such as um, er, and ah, and (4) silent pauses unrelated to linguistic juncture.[1] It seems apparent from these descriptions that such events fail to serve a linguistic function. An intriguing question, therefore, concerns what accounts for their existence. A related question, with which the present study is primarily concerned, is how these events for some speakers come to have stimulus value as "stuttering."

Efforts to arrive at an adequate understanding of the problem of stuttering have been carried out along several primary lines of inquiry. One approach has been an attempt to establish a physical basis for the problem. Numerous studies have been performed comparing stutterers with

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[1]This is a more inclusive definition of disfluency than is generally employed. For example, in the speech pathology literature the term disfluency generally refers only to vocal events, such as repetitions and interjections (Siegel and Martin, 1966), thereby disregarding pauses. The psycholinguistic literature, conversely, tends to place more emphasis on pauses (Maclay and Osgood, 1959).

nonstutterers in terms of various physiological, neurological, and biochemical criteria (Finkelstein and Weisberger, 1954; Hill, 1944; Johnson and King, 1942; Ritzman, 1943; Strother and Kriegman, 1943; Williams, 1955). A second approach has focused on stuttering as a symptom of personality disturbance or emotional maladjustment (Dahlstrom and Craven, 1952; Goodstein, 1958; Quarrington, 1953; Richardson, 1944). The third main approach has been one of investigating stuttering in terms of learning and behavior theory. Shulman (1958) was one of the earliest investigators to relate adaptation and consistency of stuttering responses to phenomena of learning. Subsequently, Wischner (1950) extended this relationship to learning in terms of generalization, extinction, and spontaneous recovery. More recently, investigators have been interested in stuttering as operant behavior (Flanagan and others, 1958).

As one evaluates these various lines of inquiry, it seems evident that attempts to establish either a physical or an emotional basis for stuttering have thus far been generally unsuccessful. Investigation of stuttering, however, within a learning and behavioral framework, particularly operant conditioning, appears more promising.

Operant paradigms that appear especially relevant to the onset and development of stuttering are conditioning with positive reinforcement, with negative reinforcement, and with punishment (Shames and Sherrick, 1963). Positive reinforcement is said to have occurred when a specified class of responses increases in frequency when followed by members of a given stimulus class, provided that there is a reduction of this frequency when such reinforcers are removed. When there is an increase in frequency of those responses which reduce or remove aversive stimuli, negative reinforcement has taken place. The weakening of responses which are followed by aversive stimuli is termed punishment. Response complexity may be increased, however, if initially neutral events are paired with aversive stimuli. Thus, as Shames and Sherrick (1963) suggest, a child may emit a disfluency as a means of postponing or avoiding an aversive or punishing consequence. Viewed through operant analysis, the disfluency is under the control of aversive stimuli.

A number of investigators have used the punishment paradigm in studying disfluency. Hill (1954) reports that when adult normal speakers are asked to perform manual responses and simultaneously compose connected speech under conditions of ambiguous stimuli (colored lights) and threat of penalty (previously conditioned shock), events occur which are strikingly similar to what is generally termed stuttering.

Savoye (1959) investigated the effect of electric shock on emission of disfluencies in normal adults during oral reading. A 10-second tone followed by shock was presented every two minutes. Experimental subjects evidenced a significantly greater number of disfluencies than control subjects.

A study using social reinforcers was performed by Stassi (1961). He evaluated the effect of verbal stimuli "right" and "wrong" on emission of disfluencies in nonsense words read by normal adults under four increasing schedules of reward and punishment. The verbal stimuli were presented in predetermined order. Although both males and females became more disfluent with punishment, the former were more affected by the 100% condition. In relating the findings of this study to the development of stuttering, Stassi concluded as follows:

> If an individual becomes disfluent as a result of punishment, and there is a persistence of this disfluency in response to specific word

> and situation cues, then it is possible that there may be some application of the results found in this study to the understanding of the onset and development of stuttering (Stassi, 1961, p. 361).

General findings from thes studies (Hill, 1954; Savoye, 1959; Stassi, 1961) indicate that when punishment (threat of penalty, electric shock, and "wrong," respectively) is administered on a noncontingent basis during a variety of verbal tasks, increased disfluency occurs. Contrary findings exist, however, when punishment is contingent on disfluency. Siegel and Martin (1965a) presented an electric shock to normal adult speakers each time a disfluency occurred during oral reading. A significant decrease in disfluency was thereby obtained. Another experiment in that study was performed to clarify the effects of contingent and noncontingent electric shock. Subjects receiving random (noncontingent) shock tended to become more disfluent whereas those receiving contingent shock showed a significant reduction in disfluency.

In a subsequent study, Siegel and Martin (1965b) evaluated the effects of verbal punishment on disfluency. Tape-recorded responses of "wrong" were delivered to normal speakers via a loudspeaker. Some of the subjects received the verbal stimulus "wrong" on a predetermined random schedule; the remainder, after each disfluency. The results indicated that random presentation of verbal punishment had no substantial effect on disfluency. A significant reduction in disfluency, however, was found when punishment was contingent on disfluency.

The preceding study was followed by one (Siegel and Martin, 1966) in which reinforcing stimuli, consisting of "wrong," "right," and a signal from a buzzer, were presented on a disfluency-contingency basis. The "Wrong" condition of the previous experiment (Siegel and Martin, 1965b) was replicated on the possibility that presentation of "wrong" might have served to alert rather than to punish the subject. Thus, the "Buzzer" condition was included to allow for a comparison with a neutral stimulus. The "Right" condition had the purpose of determining the effect of an approval stimulus.

The results for the "Wrong" condition paralleled those of the previous study; that is, there was a decrease in disfluency. This was also true of the "Buzzer" condition which appeared to indicate that disfluencies may be self-punishing. No effect was obtained from the "Right" condition except during termination of the stimulus (extinction) which resulted in an increase in disfluencies.

Statement of problem

A leading conceptualization of stuttering (Johnson, 1959) is based on the observation that disfluency exists on a continuum which includes both normal and stuttering speakers (Tuthill, 1946). That is, disfluencies essentially similar to "stuttering" occur in normal speakers; conversely, disfluencies of a "normal" nature occur in the speech of stutterers. Thus, stuttering should not be considered distinct from ordinary disfluency but rather as an elaboration of it. This point, implicit in Johnson's discussions of the onset of stuttering, is stated more explicitly by Bloodstein and others (1956).

A fundamental contention within Johnson's conceptualization of stuttering is that the previously mentioned elaboration occurs primarily as a result of a listener who behaves in a particular way. In this regard, it is maintained that a critical factor in the development of stuttering is adult (usually parental) negative reaction to a child's speech attempts rather than disfluency *per se*.

> The reasons for the onset of stuttering . . . are not to be sought most significantly within the child or even in the way he speaks, but primarily "inside his parent's head," or rather, in the parent's attitudes and reactions to the child and especially to the way the child speaks. The point not to be missed is that any child speaks with enough nonfluency[2] to be worried about and diagnosed as "stuttering," provided his parents are prepared by their conditioned attitudes, beliefs, and standards, to worry enough and to see simple repetitions and hesitancies as danger signals (Johnson, 1956, p. 242).

It is suggested (Johnson, 1959) that whatever parents do to make a child doubt his adequacy as a speaker in their eyes and make him concerned about his ability to meet their standard may result in disfluency. For example, in discussing the results of a study on the onset of stuttering, Johnson states that after the parents in the experimental group began to feel that their children were stuttering, they usually reacted in some evident manner. For the most part, they "urged the child to 'slow down,' 'relax,' and 'take it easy,' but the variety of ways in which they expressed, both verbally and non-verbally, their negative evaluations of the child's nonfluencies was considerable (Johnson, 1959, p. 231)."

These reactions, then, apparently serve to create anxiety in the child about the occurrence of disfluencies. This anxiety, in turn, results in tensions during the speaking act which make disfluencies and their elaboration more likely. Thus, whereas the child's approach to speaking previously was largely "automatic," it is now deliberate and

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[2]The more descriptive term disfluency has replaced the earlier term nonfluency since it indicates that these phenomena exist on a continuum.

effortful, and consequently more disfluent. This may, then lend confirmation to the parent's concern which may be expressed in more demonstrable form with further unsuccessful attempts at compliance by the child, and so on.

Hence, within this conceptual framework, a significant parameter in acquisition of stuttering consists of those conditions which have the effect of displacing children's disfluencies from the portion of the continuum representing normal disfluencies to that representing disfluencies that are more likely to be associated with stuttering. In the interaction theory of stuttering, the condition of verbal reprimand or punishment seems predominant. The general purpose of this investigation, therefore, was to explore the effects of an approving versus a disapproving listener on the production of hesitant speech in children. More specifically, because of its theoretical relationship to the problem of stuttering, the purpose was to evaluate the effects of verbal punishment on latency and response duration as indices of disfluency. An additional purpose was to examine the variables of age and sex. Since the onset of stuttering generally occurs early in childhood, a greater effect of punishment at younger ages appeared plausible. The sex variable was investigated since (a) previous research (Stassi, 1961) found a greater effect of verbal punishment in adult males than in females and (b) a higher incidence of stuttering is reported in males compared to females.

The following questions were asked:

(1) Are there significantly greater latency and response durations in children as a result of verbal punishment compared to reward?

(2) If so, are these effects greater in younger compared to older children, and in boys compared to girls?

PROCEDURE

Subjects

An attempt was made to obtain a representative sample of normal children in order to provide for broader generalizations. The subjects were 160 boys and girls from three Gainesville schools (two public schools and the University of Florida laboratory school). The distribution of subjects from these schools was as follows: 52, 76, and 32. They were selected from a pool of 431 children showing evidence of the following: (1) Normal speech and hearing. Each child received a score at or above the corresponding chronological age norm on the screening portion of the Templin-Darley Articulation Test. No children were included who were reported by teachers to have a stuttering problem. As a further check on this possiblility, the speech examiner excluded any children who exhibited unusual disfluency, in terms of disfluency or type, during a spontaneous speech sample. In addition, children accepted for the subject-pool passed an audiometric screening test bilaterally at 15db (1964 ISO) for 500, 1000, and 2000 Hz. (2) Satisfactory social adjustment. To be acceptable for the subject pool, children were reported by their teacher to possess adequate social adjustment. In addition, any behavior such as unusual timidity during the speech and hearing screening also served as an exclusion criterion. (3) Generally normal intelligence. The criterion in this instance was appropriate grade placement for the child's chronological age.

Alternate assignment of these children to Group A (Reward condition) and Group B (Punishment condition) was made from a randomized list of their names. Subjects were consecutively drawn from this list, insofar as scheduling arrangements would permit, so that the variables of condition, grade, and sex were alternated throughout the experiment. This continued until 160 subjects were run with 80 subjects in each condition (20 boys and 20 girls at each of two grade levels). The mean ages of 3rd and 6th grade subjects in Group A (Reward condition) were 9-0 and 11-11, respectively; for Group B (Punishment condition), these values were 8-11 and 11-11.

The parents were informed by letter (Appendix A) of the nature of the study and then contacted by telephone. Very few parents declined having their child participate or failed to keep the appointment. All (160) children who served as subjects were reimbursed. The letter to parents thanking them for the participation of their child is contained in Appendix B.

Auditory stimuli

Previous research of verbal punishment used continuous oral reading (Savoye, 1959; Siegel and Martin, 1965b, 1966) or reading of nonsense words from cards (Stassi, 1961). Since speech decoding and encoding is based primarily on an auditory rather than a visual channel, it was decided that auditory stimuli would be preferable.

The auditory stimuli consisted of tri-syllable CVC sequences with English stress pattern (primary stress on the initial syllable and secondary stress on the final syllable). They were developed by random combination of English phonemes (24 consonants and seven stress and four unstress vowels) with the constraint that no syllable represent a real word in order to minimize familiarity and recall. An initial pool of 200 nonsense words was developed from which 60 were selected on the basis of more "natural" (in terms of ease of production) phoneme combinations in English. It was judged desirable for the items to be moderately difficult in pronunciation in order to have a fairly high operant rate of disfluency but, at the same time, for them to be capable of pronunciation by the subjects, particularly at the younger level. The items presented in Table 1 were evaluated in these respects by preliminary investigation with 4th graders and found to be satisfactory.

The nonsense words were tape recorded by the experimenter (male) following a series of practice trials. They were pronounced clearly, but naturally, and in a generally uniform manner. Twenty of the items were dubbed and randomly reordered to serve as effect items.

Instructions to subjects were as follows:

> You're going to hear some strange words. They will come through the loudspeaker behind you. Listen and repeat each word immediately after you hear it. The first series of words will be practice. Then I'll tell you how well you're doing. Do you understand?
>
> You are (name),(grade), (school). Right? Repeat each word immediately after you hear it. Are you ready?

The auditory stimuli were presented freefield at a comfortable listening level which remained unchanged throughout the experiment. Approximately six seconds of silence separated the stimuli. This spacing, also determined by preliminary pilot investigation with 4th graders, was generally of an appropriate length for both the response[3] of the subject and verbal stimulus

[3]Only rarely did the response of a subject overlap the subsequent stimulus.

Table 1. Stimulus items

Test

1.	θʌl	ped	jæv
2.	baz	dɛp	jɪd
3.	dup	nʊm	lɪtʃ
4.	zap	θel	rʌtʃ
5.	bɝs	mez	lɛb

Practice

1.	gɪk	leb	zæm
2.	vor	sel	dʒʌθ
3.	bib	zɛk	wʌm
4.	gæθ	fɛt	jæd
5.	zʌl	tʃet	kig

Control

1.	næŋ	kɛp	saθ
2.	him	lez	dʒiθ
3.	gʌθ	mɛb	wub
4.	mɝŋ	bel	θæz
5.	gig	vʊb	jæθ
6.	foŋ	pɪb	zætʃ
7.	bil	tʃɪŋ	zoθ
8.	dæg	tɪʃ	lʌt
9.	kɝp	fɛb	zætʃ
10.	θib	len	ludʒ
11.	mif	kub	zat
12.	pɝb	zem	zaθ
13.	lib	wɛz	wav
14.	jup	len	guθ
15.	dut	kɪtʃ	wut
16.	giv	men	θav
17.	lim	jet	jiŋ
18.	kɝf	led	han
19.	sʌg	zel	dʌp
20.	kæk	nɪn	lʌt

Intervening

1.	lʌf	ɛɪm	tʃɝf
2.	kir	dʒam	nim
3.	gɝf	kɛs	fædʒ
4.	nim	tup	mitʃ
5.	kig	zeb	jæn
6.	mɝn	dez	gan
7.	gatʃ	tem	zæt
8.	vɝl	fɪf	jæb
9.	hof	lep	mitʃ
10.	dʌt	len	wæb
11.	zæŋ	mɪn	mudʒ
12.	hik	teʃ	kæθ
13.	dʒæl	nɪŋ	fiθ
14.	pæg	zɪs	wætʃ
15.	dæf	rɛl	ʒim
16.	vud	gek	rup
17.	fʌl	nɛm	wædʒ
18.	nɝm	pɪp	siθ
19.	pim	gɛp	tʃim
20.	tædʒ	heb	zor

Effect

1.	sʌg	zel	dʌp
2.	mif	kʊb	zat
3.	foŋ	pɪb	zætʃ
4.	næŋ	kɛp	saθ
5.	lim	jet	jiŋ
6.	mɝŋ	bel	θæz
7.	bil	tʃiŋ	zoθ
8.	θib	len	ludʒ
9.	lib	wɛz	wav
10.	gʌθ	mɛb	wub
11.	kæk	nɪn	lʌt
12.	kɝp	fɛb	zætʃ
13.	pɝb	zem	zaθ
14.	giv	men	θav
15.	kɝf	led	han
16.	him	lez	dʒiθ
17.	dæg	tɪʃ	lʌt
18.	dut	kɪtʃ	wut
19.	gig	vʊb	jæθ
20.	jup	len	guθ

Post- Treatment

1.	botʃ	keg	næm
2.	riʃ	tez	tʃof
3.	tud	rɛŋ	gɛb
4.	læl	rɛl	jɝm
5.	vaz	gɪs	tʃʌn
6.	fæs	kɪg	zof
7.	mis	jet	fan
8.	pʌθ	leb	dʒim
9.	ræb	tɪb	nɝtʃ
10.	bop	sɪθ	jæb

of the experimenter.

The auditory stimuli were presented in three continuous phases: pre-treatment, differential treatment, and post-treatment. These phases[4] constituted the experimental design depicted in Table 2. Pre-treatment consisted of test, practice, and control periods. The test period, containing five items, served as a final screening procedure. If the child was capable of pronouncing items four and five, he was used as a subject--all children tested in this procedure met this requirement. During the test period the child was freely rewarded and encouraged for his pronunciation attempts. The practice period also contained five items. Its purpose was to further familiarize the subject with the type of items being used and to stabilize his responses. Verbal stimuli from the experimenter were withheld during this period. The control period of 20 items served as a reference against which the effects of differential treatment were measured. Thus, no reinforcements were administered.

Differential treatment consisted of consecutive intervening and effect period, each containing 20 items, during which Group A received a positive schedule (80 percent reward/20 percent punishment) and Group B a negative schedule (80percent punishment/20 percent reward) of reinforcement. The interpolated items of the intervening period served two purposes: (1) to reduce memory of the control items and (2) to provide for a build-up of any experimental effects due to differential treatment. Effects were measured on the items of the effect period. As indicated previously, these items were dubbed copies of the control items but were presented in a different order.

Post-treatment contained 10 items, each followed by reward. This procedure was followed in order for each subject to terminate the experiment

[4]Labeled as Conditions in Table 2.

Table 2. Experimental design: conditions, periods, number of items, and reinforcement.

Conditions	Pre-treatment			Differential Treatment		Post-treatment	
Period	Test	Practice	Control	Inter-vening	Effect[2]	Termination	
Number of Items	5	5	20	20	20	10	Total 80
Reinforcement	Free[1]	None		80% Reward/ 20% Punishment		100% Reward	Group A[3]
Reinforcement	Free	None		20% Reward/ 80% Punishment		100% Reward	Group B

[1] No constraint on reinforcement -- experimenter free to administer whatever positive reinforcement needed to obtain appropriate responses.

[2] Identical nonsense items to those of Control period but presented in different random order.

[3] Each group consists of third and sixth graders, 20 boys and 20 girls from each grade -- total number of subjects, therefore, is 160.

with feelings of success.

Reinforcements

Verbal stimuli consisted of reward ("right," "good," and "mmm-hmm") and punishment ("wrong," "no," and "huh-uh"). Classes of stimuli were utilized, rather than "right" and "wrong" as in previous research (Stassi, 1961 and Siegel and Martin, 1965b; 1966), in order to provide a more natural and "lifelike" situation. For this reason, plus that of allowing for varying latency and response duration, the verbal stimuli were administered "live" by the experimenter seated across from the subject, rather than via a tape recording. An attempt was made to maintain relatively uniform verbal stimuli throughout the experiment by delivering them in a factual manner and at about the same length of time following each subject's response. The reinforcements were given in a predetermined sequence that had no necessary relation to a subject's hesitations or accuracy of pronunciation. This mode (non-contingent) was selected since previous research (Savoye, 1959 and Stassi, 1961) had demonstrated an effect of increased disfluency as a function of punishment.

Identical items in the differential treatment phase were assigned either positive or negative verbal stimuli according to the particular reinforcement schedule. For example, item five of the effect period was assigned "good" for the positive schedule and "no" for the negative schedule.

Dependent variables

Previous studies have rated (Stassi, 1961) disfluencies or counted them (Siegel and Martin, 1965b; 1966). Using a nine point fluency-disfluency scale, Stassi rated nonsense words read under a series of reinforcement conditions and then computed average values. Estimates of rater reliability were not provided. Siegel and Martin, on the other hand, depressed a response switch for each disfluency during oral reading which activated a counter.

Although their system yielded high observer reliability of disfluency, durational information of disfluency was excluded. For example, a series of repetitions of a sound or word was counted as a single repetition. In addition, as indicated earlier, their measure of disfluency did not include inappropriate pauses.

All types of disfluency, whether they be hesitations, repetitions, prolongations, interjections, or silent pauses, are represented on the time dimension in terms of duration. This attribute, therefore, provides the possibility of relatively objective and precise measurement by temporal analysis. Thus, in the present investigation, latency and response duration were selected as the dependent variables. Latency referred to the time from the end of an auditory stimulus to the beginning of a subject's utterance; response, to the time from the beginning of a subject's utterance to its termination.

Apparatus

The nonsense words (auditory stimuli) were recorded in a series 1200 Industrial Acoustic Corporation room by means of an Ampex 351-C full-track tape recorder (located outside the sound chamber) and an Altec M-2 microphone system.

The experimental situation and equipment used for presentation of the nonsense items are illustrated in Figure 1. The facility consisted of two 12' x 12' adjoining rooms with a one-way mirror between them. One room served for subject testing; the other, as a control room. The test room was attractively furnished in a somewhat "homelike" atmosphere. In addition to a table and two comfortable chairs placed across from each other, it contained two lounge chairs. The room was carpeted, and drapes covered one wall. These sound absorption materials, plus acoustic tile

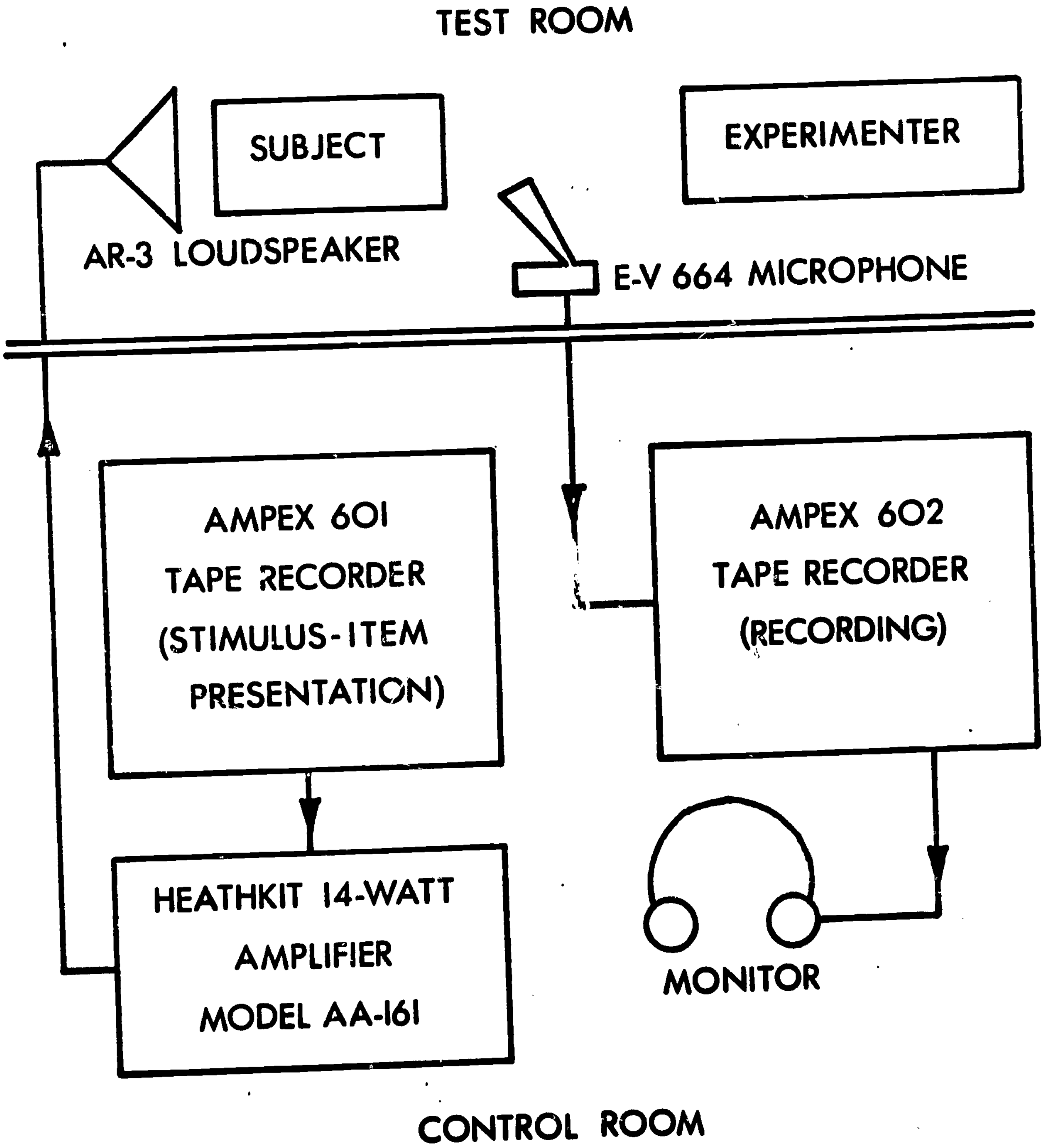

Figure 1. Experimental situation and equipment.

on the ceiling and the wall separating the two rooms, provided satisfactory acoustic characteristics for auditing the stimuli and recording subject responses. Other items in the test room were an AR-3 loudspeaker and an Electro-Voice 664 microphone.

The control room contained the remainder of the equipment for playback and recording. The prerecorded nonsense words were played on a full-track Ampex 601 tape recorder connected to a Heathkit 14-watt amplifier, Model AA-161, driving the loudspeaker in the test room. Recording of the subject responses, as well as the auditory stimuli and reinforcements, was via a full-track Ampex 602 tape recorder connected to the test-room microphone. The operator monitored the playback and recording by means of a pair of earphones.

The dependent variables, latency and response duration, were measured by means of a graphic display of the speech signal. The experimental recordings were played from an Ampex 602 tape recorder (the same one used for recording) to a B & K Level Recorder, type 2305, through a B & K Audio-Frequency Spectrometer, type 2112 (operated on the linear scale), which served essentially as an impedance matching device. Paper and writing speeds were 30 and 315 millimeters per second, respectively. The readout was in terms of time and amplitude of the input signal. This system and its readout are depicted in Figure 2.

<u>Identification and measurement of latency and response</u>

It was essential that the dependent variables be uniformly processed for each of the independent variables. Thus, specific identification and measurement procedures were carefully and consistently followed. Identification consisted of two procedures: first, an assistant using the equipment previously described and illustrated in Figure 2, marked the

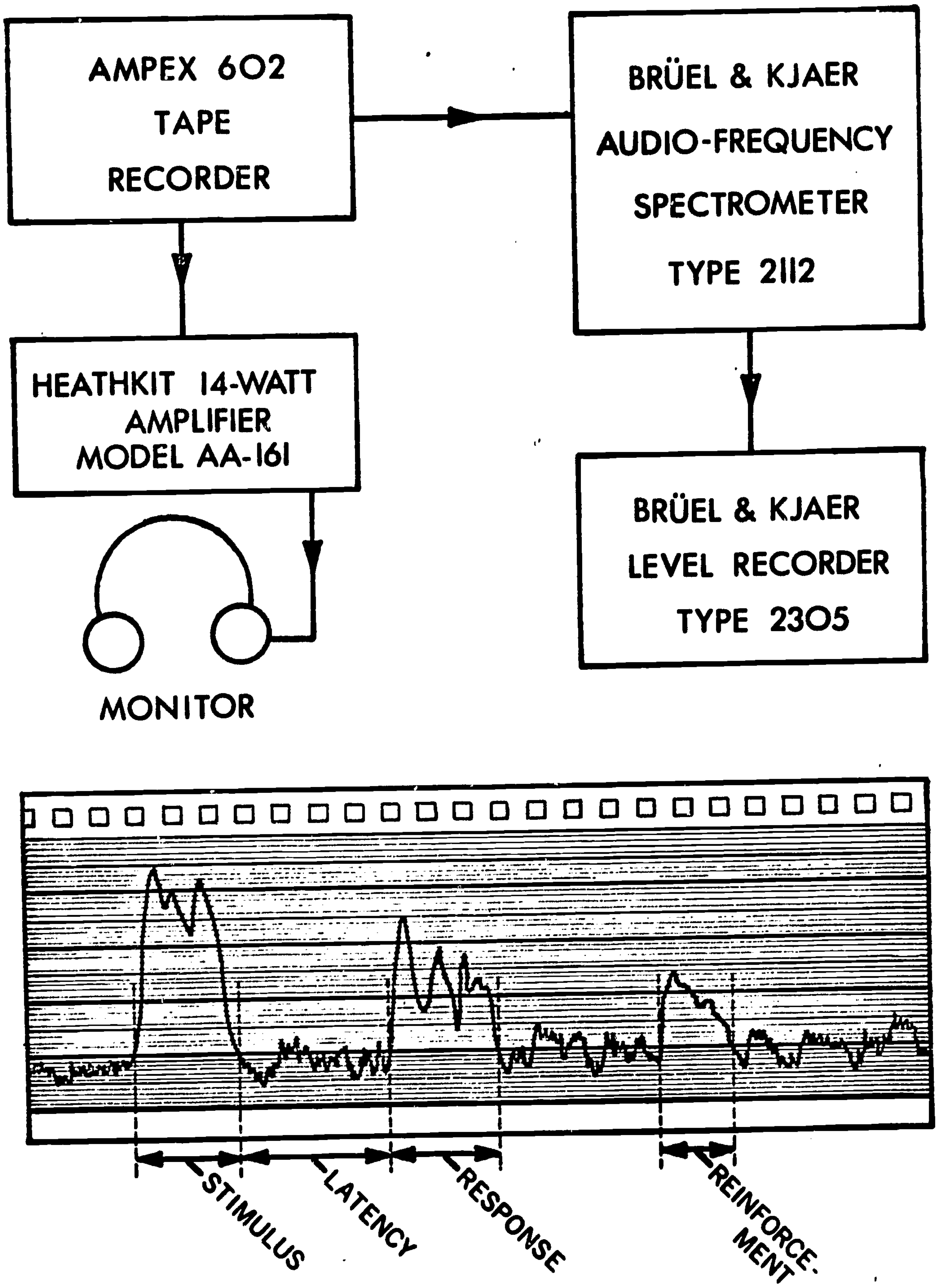

Figure 2. Apparatus for identification and measurement of response latency and duration.

approximate beginning and end of each speech response on the graphic level recording paper as she monitored the control and effect items of each subject's tape recording. The graphic recorder was re-calibrated prior to each set of control and effect items. Second, another assistant, using a set of rules with associated illustrations (Appendix C), made more precise determinations of the beginning and end of the criterion measures.

There generally was little difficulty in perceiving when responses began and ended. A few tape recordings, however, contained a sufficiently high noise level that it was not entirely clear from the visual record when the speech signal ended.[5] In these instances a decision concerning termination of the response was made by means of a set of rules referred to above. In brief, the rules specified the necessary amplitude of any peak in question and the lateral distance within which the peak should lie from the previous major peak in order to be accepted as part of the speech signal. It was assumed that any low-energy noise which served to mask visually the termination of responses was essentially random and affected all treatment groups similarly. Since care was taken to alternate subjects from the various treatment groups (conditions, ages, and sexes) during the experiment, it is felt that no consistent effect due to this circumstance existed for any treatment group.

In order to eliminate a like difficulty in determination of the end of the stimulus so that the beginning of any latency event would be clear, an arbitrary point was selected for each experimental stimulus in its graphic display and measurements for all subjects were made from that point.

[5]Visual masking of the speech signal due to noise occurred almost solely at the end of the response rather than at its beginning.

A further technique to equalize measurement, in this case variation in intensity of subject utterance, was by identifying all events in terms of amplitude peaks rather than slopes. In this way effects due to the pen having to travel greater distances to the peak and return to the baseline on higher intensity signals were partially compensated. Actual measurement simply involved placing a millimeter ruler on the graphic level recording paper and recording the duration of each designated latency and response event.

Judge agreement in identification and measurement of latency and response

A sample of sixteen recordings was selected for estimating judge agreement. This selection contained approximately an equal number of subjects from the various treatment groups, as well as when (considered in terms of early, middle, or late) they were used in the experiment.

One specially trained assistant, using the procedure earlier described, obtained graphic level recordings of the control and effect items for all sixteen subjects on two separate occasions. These copies were then re-marked for latency and response events by the operator and a second judge independently, both using the rules contained in Appendix C.

A difference in measurement between the judges of more than one millimeter at either the beginning or end of latency and response was considered a disagreement. The number of agreements and disagreements was summed across subjects (16) for latency and response separately with respect to each of the control and effect items and proportions computed therefrom.[6]

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[6]Appreciation is expressed to Dr. A. E. Brandt for his suggestion of this method of evaluating judge agreement.

The formula was

$$P = \frac{d + \frac{a}{2}}{n}$$

where $\underline{P}$ referred to the proportion of disagreements adjusted for exact agreements (ties), $\underline{d}$ the number of agreements, and $\underline{n}$ the total number of observations in a set. This method does not yield a quantitative estimate of the degree of agreement between judgments. Instead it provides statistical criteria (proportional values) upon which to base categorical statements that judges do or do not agree.

There were 1,262 individual events which were divided, as indicated above, into 80 sets of 15 or 16 observations (depending on whether void items occurred),[7] each set yielding a P-value. The largest of the resultant P-values was .67 which failed to reach the .01 percent level of significance (.75). This finding indicated that the distributions of judgments from the two judges were similar enough so that one could reasonably retain the hypothesis that these sets of judgments were random samples from the same population. Thus, the two sets of judgments were considered to be parallel, that is, in agreement, which provided evidence of the general reliability of these data as a group.

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[7] Eighteen events of the total (1,280) were void due to instrumentation variation.

ANALYSIS OF DATA AND RESULTS

Analysis of variance and covariance were used to evaluate the relations among the four dichotomous factors (independent variables) to the criteria (dependent variables). The factors were: period (control and effect), condition (reward and punishment), grade (3rd and 6th) and sex (male and female). The criteria were latency and response. In a preliminary analysis another dimension--item (20 nonsense words)--was included as a basis for critical evaluation of the relative utility of the individual items. In a subsequent analysis, the total of the items was used with the four dichotomous factors.

Analysis I

Analysis of variance: latency

Bartlett's test for homogeneity of variance yielded a Chi-square of 2158.99 based on 319 degrees of freedom. Thus, one must conclude that the contributions to error were not equal within the limits of random sampling.

A partial summary of the analysis of variance for latency is presented in Table 3. Only those sources of variance significant at or beyond the .05 level of confidence are included. In view of the heterogeneity of variance, the significant effects listed in the table cannot be attributed solely to levels or means.

Even if the contributions to error variance had been homogeneous, most of the differences between means are too small to be of practical value in evaluating the effects of the experimentally imposed factors on the temporal indices of disfluency. This is true even though the evidence

Table 3. Partial* summary of analysis of variance for Analysis I: latency.

Source	df	ms	F
Period (A)	1	470.89	6.71
Condition (B)	1	643.89	9.18
Grade (C)	1	463.33	6.60
Sex (D)	1	2083.92	29.70
Item (E)	19	5627.37	80.20
A X B	1	696.95	9.96
A X C	1	620.01	8.86
A X D	1	661.76	9.45
B X D	1	3124.81	44.64
C X D	1	2342.56	33.46
B X C X D	1	486.20	6.95
Error: within-treatments	6080	70.17	

*Significance at or beyond the .05 level would be strong as to the direction of differences.

Analysis of variance: response

Bartlett's test (Chi-square of 1984.41 for 319 degrees of freedom) again leads to the conclusion that the treatment groups cannot be considered as random samples drawn from populations of equal variance. Thus, the conclusions in regard to the statistically significant comparisons for the main effects and interactions (presented in Table 4) for response are the same as for latency, except for grade. In this instance, the difference in mean durations of response for 3rd and 6th grades, 34.18mm versus 30.22mm, respectively, may be great enough to be of practical value.

Analysis of covariance: latency and response

A small cross-product mean square for error was obtained from this analysis which resulted in no significant changes in iterpretation of response when adjusted for latency.

Analysis II

Analysis of variance: latency

Bartlett's test for homogeneity of variance gave a Chi-square of 37.46 for 15 degrees of freedom which was significant at the .01 level. Hence, as before in Analysis I of latency, the evidence indicated that the treatment groups should not be treated as random samples drawn from populations of equal variance.

For 1 and 200 degrees of freedom, a value of F approximately equal to 6.76 is significant at the one percent level and 3.89 at the five percent level. From Table 5 it may be seen that none of the main effects reached significance. When the variability among the individual items was removed by using the total of the items, the number of observations was

Table 4. Partial* summary of analysis of variance for Analysis I: response.

Source	df	ms	F
Period (A)	1	610.68	6.17
Condition (B)	1	3652.69	36.88
Grade (C)	1	25126.21	253.70
Item (E)	19	2507.60	25.32
B X C	1	766.60	7.71
B X D	1	3762.28	37.99
C X D	1	1015.22	10.25
B X C X D	1	664.99	6.71
Error: within-treatments	6080	99.04	

*Significance at or beyond the .05 level.

Table 5. Complete summary of analysis of variance for Analysis II: latency.

Source	df	ms	F[1]
Period (A)	1	214.22	1.56
Condition (B)	1	256.73	1.89
Grade (C)	1	4.55	
Sex (D)	1	437.62	3.22
A X B	1	63.16	
A X C	1	458.85	3.37
A X D	1	162.14	1.19
B X C	1	53.76	
B X D	1	376.25	2.77
C X D	1	577.77	4.25*
A X B X C	1	6.64	
A X B X D	1	36.07	
A X C X D	1	1.09	
B X C X D	1	265.76	1.95
A X B X C X D	1	0.02	
Error: within-treatments	304	136.01	
Total	319		

*Significant at the .05 level

[1]F was not calculated when the error mean square was larger than a factor mean square.

greatly reduced. As a result, contrary to the previous analysis of latency, none of the main effects was significant.

The only significant interaction (Table 5) was C X D. Since neither the C effect nor the D effect was significant, this significant interaction is difficult to interpret except in the presence of synergism or potentiation. Inasmuch as none of the other comparisons in this analysis was significant, the interaction of grade and sex may have been fortuitous.

It is particularly important to observe that neigher the main effect of B nor its interactions was significant. This indicates that the conditions of reward and punishment failed, on the average, to be differential with respect to latency.

Analysis of variance: response

Bartlett's test for homogeneity of variance was applied and, as in all of the previous analyses, a significant Chi-square was obtained.

A complete summary of the analysis of variance for response is presented in Table 6. The effect of condition was significant at the .05 level. The mean duration of responses for punishment (32.99) was significantly longer than for reward (31.49). It must be remembered, however, that since the treatment group contributions to error variance were found to be heterogeneous, it is not safe to assume that this finding is related only to levels or means.

A highly significant mean square for grade was obtained. The means for 3rd and 6th grades, 34.15 and 30.32, respectively, were significantly different which indicated that the 3rd graders, compared to the 6th graders, showed substantially longer responses. The same precaution, however, regarding interpretation of this effect must be made as in the previous paragraph.

Table 6. Complete summary of analysis of variance for Analysis II: response.

Source	df	ms	F[1]
Period (A)	1	73.09	
Condition (B)	1	717.35	5.99*
Grade (C)	1	4694.86	39.15**
Sex (D)	1	0.98	
A X B	1	4.80	
A X C	1	1.31	
A X D	1	62.36	
B X C	1	85.76	
B X D	1	809.91	6.75*
C X D	1	187.39	1.56
A X B X C	1	61.36	
A X B X D	1	19.09	
A X C X D	1	5.21	
B X C X D	1	57.24	
A X B X C X D	1	63.96	
Error: within-treatments	304	119.93	
Total	319		

*Significant at the .05 level
**Significant at the .01 level

[1]F was not calculated when the error mean square was larger than a factor mean square.

The main effects of period and sex were not significant.

Of the various interactions only B X D was significant. From Figure 3 it may be seen that this interaction effect resided within the fact that females gave shorter responses than the males under the reward condition, but longer responses than the males under the punishment condition.

Analysis of covariance: latency and response

Since none of the comparisons that were significant in the analysis for latency was also significant in the analysis for response, the analysis of covariance was omitted.

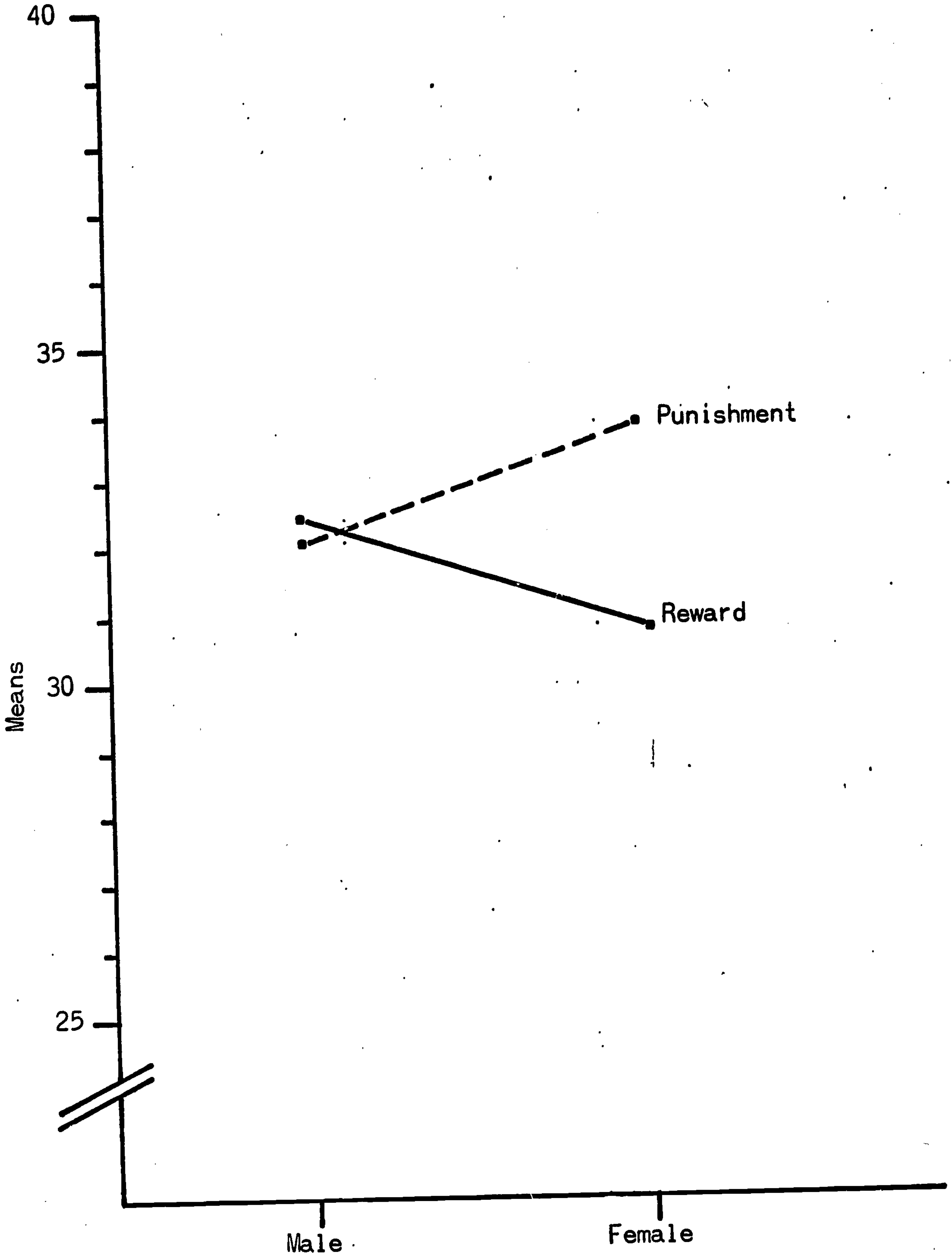

Figure 3. Graph illustrating B X D interaction (Analysis II: Response).

DISCUSSION AND CONCLUSIONS

A prominent and pervasive outcome throughout these analyses is the finding of heterogeneous variance. Consequently, interpretation of results is difficult since significant effects may not be considered as being related only to treatment levels or means. This finding, however, is of major importance in and of itself since it indicates that verbal behavior in children, as measured by latency and response duration, is highly variable in a verbal reward/punishment situation of the type employed. From this, it may be concluded that intrinsic characteristics exist among children which need to be isolated if maximal understanding of disfluent behavior is to be achieved. Such characteristics may relate to frequency and type of disfluency, ability to auditorize and produce unfamiliar phonemic sequences, past history of approval and disapproval, level of aspiration, and so on. In future studies of this phenomenon, it would be advisable to stratify subjects in terms of these parameters and use subjects as their own controls in evaluating treatment effects, thereby reducing unknown sources of variance. For the present, however, these data warn that the general tendency in the literature of interpreting adult findings as applicable to children may be unwarranted.

The first analysis indicated that the effects of the individual items on the duration of latency and response were not consistent from individual to individual and group to group. Further study of these data might reveal that some of these items are consistent in this regard and could be used to evaluate differences and duration of latency and response or that they are consistent in regard to some other means of measuring disfluency, for example, perceptual analysis.

More specifically, but keeping in mind the previous discussion, it may be concluded from these analyses that latency, as an index of disfluency, appears to be unrelated to reward and punishment for both grade (3rd and 6th) and sex. In other words, neither reward nor punishment has an effect on the amount of time taken to formulate and begin expression of heard nonsense words.

This may not be said, however, of response as an index of disfluency. The findings indicate that 3rd grade children, on the average, have longer responses than 6th grade children in this particular type of verbal situation, but not necessarily as a result of verbal punishment. Of particular interest, however, is the general finding that verbal punishment compared to reward, appears to be associated with a significant increase in utterance duration, thereby indicating increased disfluency. In terms of interaction effects, there appears to be a relationship between reward and punishment for females but not for males. That is, females evidence shorter responses than males when rewarded and longer responses when punished. This finding is in contradiction to that of Stassi (1961) who found males more affected by punishment than females. Once again, however, it must be remembered that his subjects were adults. A further consideration in this regard relates to the higher incidence of stuttering found in males. Assuming that verbal punishment plays a fundamental role in the development of stuttering, a greater effect of verbal punishment in males would be expected. Thus, a question of an inferential nature is raised which necessitates further empirical study.

SUMMARY

The general purpose of this investigation was to explore the effects of verbal reward and punishment on disfluent behavior in children. Particular attention was given to punishment because of its theoretical relationship to the problem of stuttering. Latency and response duration were used as indices of disfluency. More specifically, the purposes were to determine (a) whether there were significantly greater latency and response durations for verbal punishment compared to reward, and (b), if so, whether these effects were greater in younger compared to older children, and in boys compared to girls.

Third and 6th grade children from three schools were (a) screened for normal articulation, fluency and hearing, and (b) evaluated for satisfactory emotional adjustment via teacher report and school records. One hundred sixty children were randomly selected with respect to these criteria. Twenty boys and 20 girls at each grade level were assigned randomly to each of two treatment groups (80 percent reward/20 percent punishment and vice versa).

Prerecorded tri-syllable nonsense words of English CVC combinations and stress pattern were presented free-field at a comfortable listening level. Reward ("good," "right," "mmm-hmm") or punishment ("no," "wrong," "huh-uh") was delivered after each pronunciation by live voice in a factual manner on a predetermined basis. Subject responses were tape recorded. Graphic level recordings of control and experimental items were analyzed

for latency and response duration. The data were treated by analysis of variance and covariance.

General evidence of heterogeneity of variance indicated that the populations from which the samples were drawn differed significantly in dispersion of disfluency on the items presented, as measured by duration of latency and response. It was concluded that intrinsic characteristics exist among children which need investigation if a better understanding of disfluency in children is to be obtained. Until such information becomes available, the general tendency in the literature of interpreting adult findings as applicable to children appears unwarranted.

Within the limitations imposed by the finding of heterogeneity of variance, the conclusions directly relevant to the questions that this study was designed to answer may be summarized as follows:

1) Verbal reward and punishment do not have a differential effect on latency of verbal responses.

2) Verbal reward and punishment have a differential effect on duration of verbal responses, the responses for punishment being longer than those for reward.

3) Verbal reward and punishment have a differential effect on verbal responses for females (shorter utterances with reward and longer utterances with punishment) as compared to males who show no difference between these conditions.

4) Younger children (3rd grade) evidence longer responses generally than older children (6th grade). This effect, however, does not appear to be related necessarily to verbal punishment.

APPENDIX A

UNIVERSITY OF FLORIDA
GAINESVILLE, 32601

COMMUNICATION SCIENCES LABORATORY
DEPARTMENT OF SPEECH

We are conducting a study, supported by the U. S. Office of Education, which we believe will provide highly useful information concerning language behavior in children. P. K. Yonge Laboratory School is cooperating with us on this project.

We would like to include your youngster, who has already passed a speech and hearing test at his school.

This project involves having each child repeat a series of strange and unfamiliar words. After he has practiced a number of words, he will be told how well he is pronouncing them. The full procedure will take approximately twenty minutes. You may stay and observe, if you desire. Those who wish to have their children participate will receive $3.00 plus $1.00 for travel expense.

We will be contacting you by telephone to schedule a definite appointment. We are most appreciative of your help.

Sincerely yours,

Paul J. Jensen

Paul J. Jensen, Ph.D.
Research Assistant Professor

S. Paul Moore

Paul Moore, Ph.D., Chairman
Department of Speech and
Director, Communication
Sciences Laboratory

PJJ/PM:pl

UNIVERSITY OF FLORIDA
GAINESVILLE, 32601

COMMUNICATION SCIENCES LABORATORY
DEPARTMENT OF SPEECH

We are conducting a study, supported by the U. S. Office of Education, which we believe will provide highly useful information concerning language behavior in children. The Alachua County Board of Public Instruction is cooperating with us on this project.

We would like to include your youngster, who has already passed a speech and hearing test at his school.

This project involves having each child repeat a series of strange and unfamiliar words. After he has practiced a number of words, he will be told how well he is pronouncing them. The full procedure will take approximately twenty minutes. You may stay and observe, if you desire. Those who wish to have their children participate will receive $3.00 plus $1.00 for travel expense.

We will be contacting you by telephone to schedule a definite appointment. We are most appreciative of your help.

Sincerely yours,

Paul J. Jensen, Ph.D.
Research Assistant Professor

Paul Moore, Ph.D., Chairman
Department of Speech and
Director, Communication
Sciences Laboratory

PJJ/PM:pl

APPENDIX B

UNIVERSITY OF FLORIDA
GAINESVILLE, 32601

COMMUNICATION SCIENCES LABORATORY
DEPARTMENT OF SPEECH

June 3, 1966

Dear Parent:

The enclosed check is for your child's participation in our language research project. We realize that there can never be full compensation in a cooperative undertaking that involves families but we do thank you very much for your help and for making the special arrangements needed for the appointment.

We feel that the information which will come from this project will be of importance in extending our knowledge about language behavior in children and we want you to know that you contributed to it in a fundamental way.

Please express our thanks to your child. It is indeed a pleasure to work with such cooperative children and parents.

Thank you again.

Very sincerely yours,

Paul J. Jensen

Paul J. Jensen, Ph.D.
Research Assistant Professor

Paul Moore

Paul Moore, Chairman
Speech Department and
Director, Communication
Sciences Laboratory

APPENDIX C

RULES FOR FINAL DETERMINATION OF BEGINNING AND END OF LATENCY AND RESPONSE

Refer to Figure 4 of this Appendix for illustrations of the various types of events relating to the identification and measurement of latency and response.

Beginning of latency

In order to provide for uniform measurement of the beginning of each latency event, a predetermined reference point has been established with respect to the termination of the preceding stimulus item. For example, the reference point (the beginning of latency) for control item six (Figure 5) is the last shoulder occurring at approximately 36dB. Draw a line perpendicular to the base line of the B & K paper corresponding to each of these reference points.

Beginning of response

The beginning of the response is determined by the following considerations:

1) Any signal below 20dB is excluded, even if it is a peak clearly away from the noise.

2) Any response peak (Figure 5), shoulder or deviation (Figure 4) above 20dB, however, should be designated as the beginning point for a response. A vertical line is placed next to the point where the line deviates from the major slope of the curve, going in a noise to peak, or upward direction.

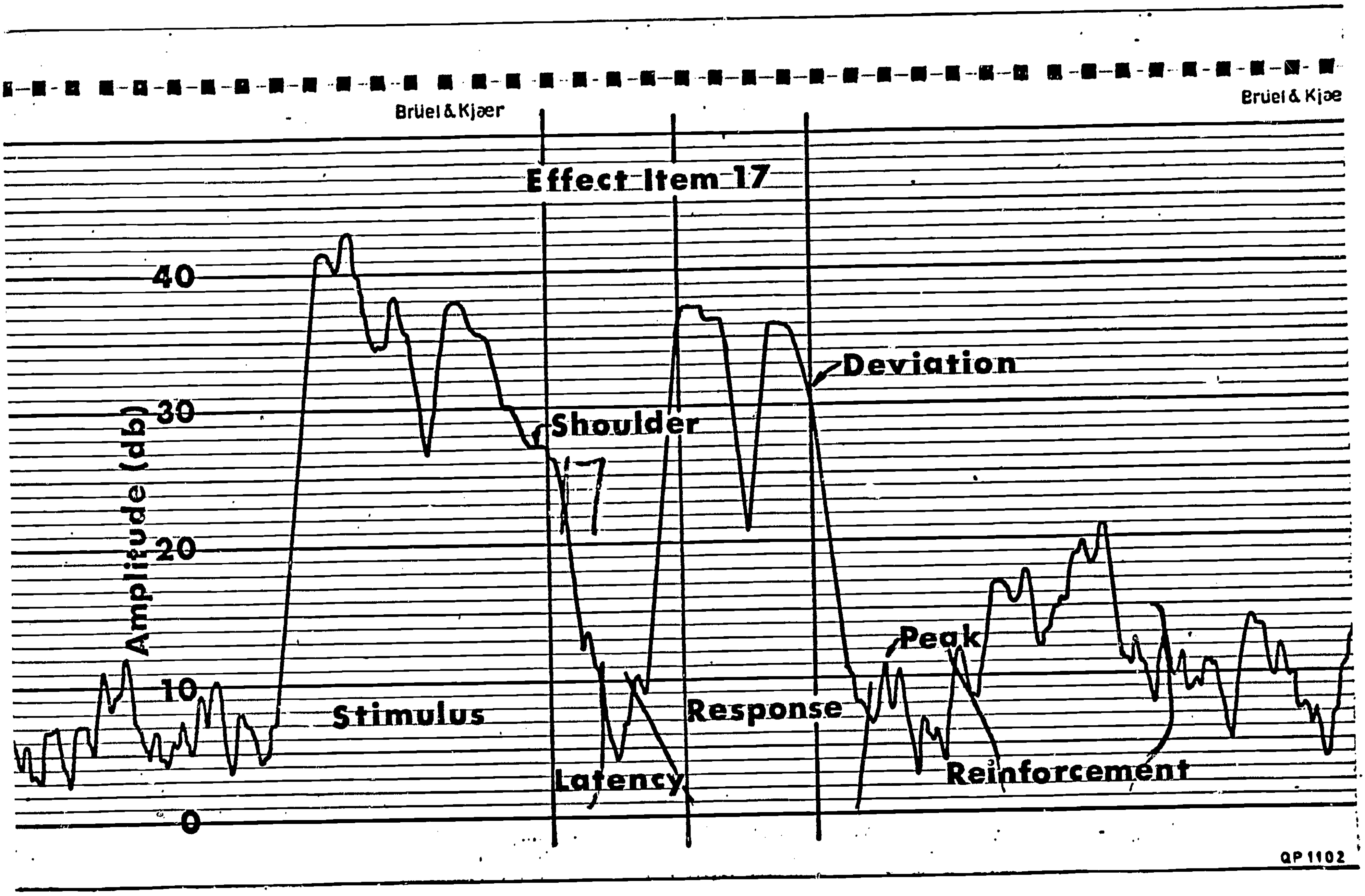

Figure 4. Illustrations of events relating to identification and measurement of latency and response.

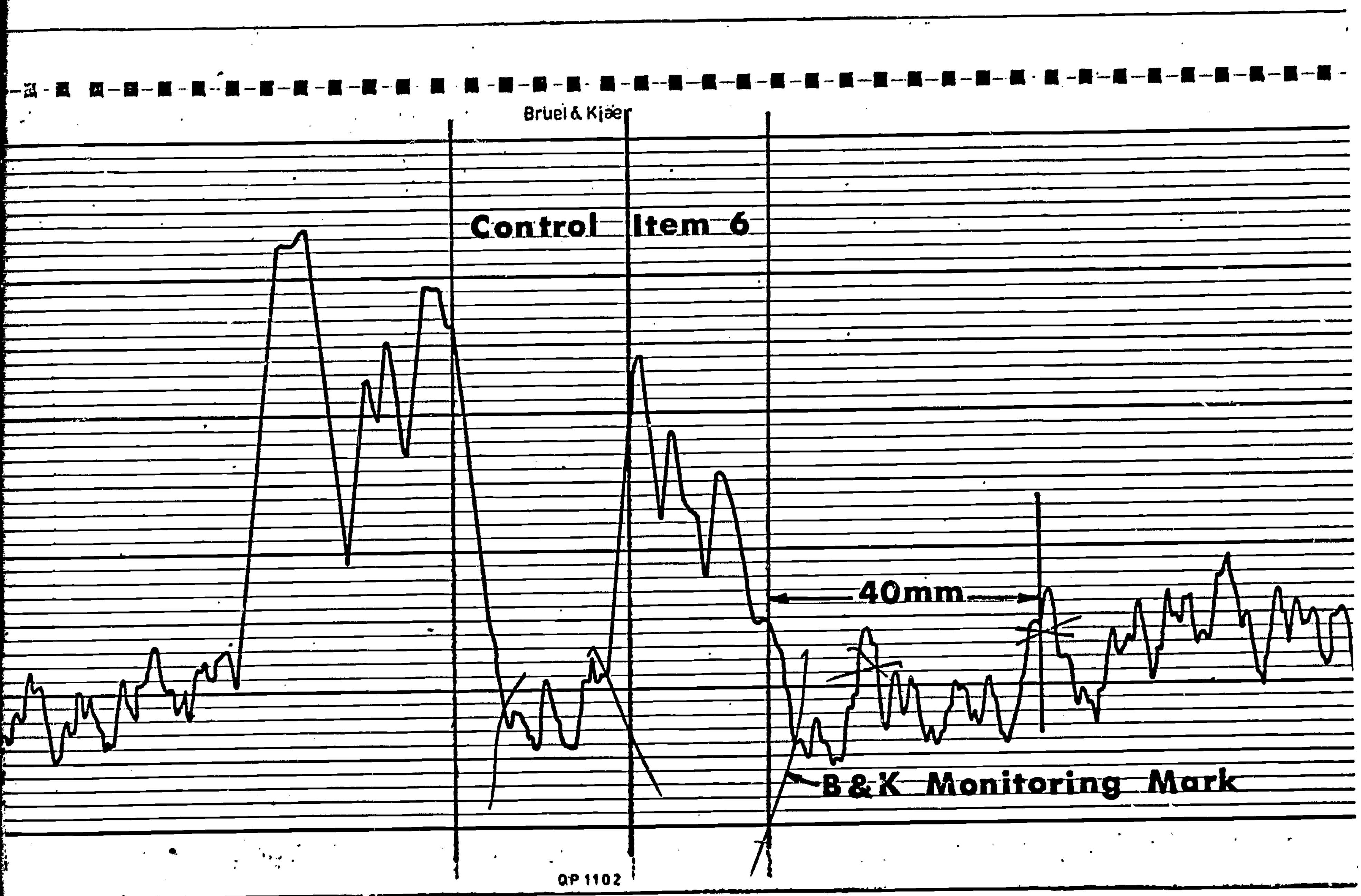

Figure 5. Additional illustrations of events relating to identification and measurement of latency and response.

End of response

General Rules:

1) The marks placed by the B & K operator indicate the approximate beginning and end of a response and its associated reinforcement.

2) Exclude all peaks that are separated laterally by more than five millimeters from the major downward slope of the response (measured to the outermost edge of the peak's tip).

Specific Rules:

1) Below 10dB, exclude any peaks, shoulders, or deviations.

2) Above 10dB, a peak is included only if the noise level, within 40mm to the right, is one dB or more lower in intensity. Measurement of 40mm begins from the center of the response peak in question (Figure 5).

3) Above 15dB, peaks and shoulders (at least one millimeter in width) are included if the noise level within 40mm to the right is one dB or more lower in intensity.

4) Peaks, shoulders of any width, and any deviations are included above 20dB.

Exceptions:

1) The reinforcement should not be used as a noise reference.

2) If part of a signal has an X across it, it is not used as a noise reference. An X indicates that the noise is of an extraneous nature to the response, e.g., irrelevant vocalization, tapping of the microphone, etc. (Figure 5).

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