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By-Lovitt, Thomas C.

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To ascertain some diagnostic functions of conjugate reinforcement, narrative stimuli, music or stories, were continuously provided the subjects contingent upon their responding. Thus, data relevant to the processes of listening, discrimination, and preference were continuously provided throughout five studies. The majority of the subjects were members of classes for children with behavioral disorders at a mental retardation and child development center. During the first study, listening and discrimination rates were obtained, whereas during the second study the discrimination of gradually increasing and decreasing response rate requirements was investigated. The purpose of the third study was to establish subject preference for certain types of music, while the objective of the fourth was to determine individual preference for a male or female reader. The fifth investigation sought to determine the relationship of sequential and simultaneous choice. (Author/JD)

FINAL REPORT

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DIAGNOSTIC IMPLICATIONS OF CONJUGATE CONTINGENCIES

JULY 1968

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
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Final Report

Grant No. OEG-1-7-070017-4269

Diagnostic Implications of Conjugate Contingencies

Thomas C. Lovitt

University of Washington

Seattle, Washington

July 31, 1968

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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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SUMMARY

Throughout the five studies of this report, conjugate reinforcement was employed. Characteristic of this method of assessment is that the availability of the narrative stimulus, either stories or music, is a direct function of the subject's behavior.

During periods of conjugate assessment the subject is placed in a small room and provided headphones and a handswitch. He is then told that either stories or music will be available and that he may press the switch if he desires. Nothing more is told the subject--when he should press the switch, how fast, or if at all.

Throughout some of these investigations, only one stimulus is available, whereas during others, two stimuli are simultaneously presented. When one narrative is provided, two conditions may be arranged. One, the programer may arrange the setting so that to increase the intensity of a stimulus from zero to a predetermined maximum level of intensity, the subject must maintain a steady rate of responding (increase conditions). Two, the setting may be arranged so that subject responding will decrease the intensity of a stimulus from its maximum to a zero level (decrease conditions). The rate of responding required to either totally increase or decrease a stimulus is individually determined.

When two stimuli are simultaneously presented and continuously available to the subject, one setting is employed by the conjugate programer. Now if the subject responds at or beyond a preset rate he increases the intensity of one stimulus while decreasing the intensity of the alternate stimulus. However, should he not respond, he is provided the alternate stimulus, the one he had previously attenuated by his responding.

The cumulative record of subject responding obtained throughout conjugate assessment sessions provides the examiner with a continuous analysis of the subject's responding. This record also reveals continuously the intensity of the narration that is being received by the subject.

Conjugate Contingencies: An Auditory Assessment Technique

The purposes of this research were threefold: (1) to determine individual listening deficits, (2) to assess individual discrimination deficits, and (3) to determine individual stimulus preferences.

Twenty-three male subjects, ranging in age from 5-10 to 14-3 from either the Division of Child Health or the Experimental Education Unit of the University of Washington were involved in the study.

The investigation comprised three stages. During the first, each subject's base rate of responding was obtained. These initial rates of responding were then used to establish the response rate requirements throughout the remainder of the investigation.

The second stage, composed of three sessions, was designed to determine each subject's rate of listening. During certain portions of this stage the subject had to respond to obtain the stimulus, whereas at other times responding attenuated the stimulus. Narration at the rate of 180 wpm was programed during the first session, 120 wpm during the second, and 240 wpm during the third.

The three sessions of stage 3 were designed to assess each subject's discrimination rate as well as his preference for rate of speech. Whereas but one stimulus was available at any one time during stage 2, two stimuli were simultaneously offered during each session of stage 3. During the initial session, narration at the rates of 180 and 240 wpm were offered. During the second session the speech rates offered were 180 and 120 wpm; throughout the final session they were 240 and 120 wpm.

Deficit Discrimination Rates and Ratios were formulated that provided a measure of each individual's ability to discriminate between stimuli. Furthermore, stimulus preferences, based on differential rate of responding throughout the three sessions of stage 3, were obtained.

The results indicated that when each subject's median listening ratio was selected, 15 had ratios of from 0 - 25%, 7 from 26 to 50%, 1 from 51 to 75%, and 0 from 76 to 100%. Similarly, when median discrimination ratios were plotted, 8 had ratios of from 0 - 25, 1 from 26 to 50, 2 from 51 to 75, and 9 from 76 to 100.

When preferences for speed of speech were calculated, it was revealed that five chose speech at the 120 wpm, four the 180 wpm rate, and nine the 240 wpm rate.

Response Rate as a Function of Increasing and Decreasing Conjugate Reinforcement Requirements

The present study was designed to probe further the use of conjugate contingencies to assess behavior. Specifically, the purpose was to determine the function of steadily increasing and decreasing response requirements on rates of responding with three experimentally sophisticated boys, ages 10-13.

Each session consisted of two episodes. In the first the response requirements were steadily increased, while in the second they were steadily decreased. In the first segment of the increase episode, the response rate requirement was set at 20; in following segments, these were increased to 30, 40, 60, 80, and finally 120 responses per minute. In the decrease episodes, the rate requirements were programed in reverse order. From four to seven such sessions of both increasing and decreasing episodes were run for each subject.

The results of this study indicated that two subjects' rates of response were directly related to the independent variable--increasing or decreasing response requirements. One subject, however, continually over-responded, regardless of rate requirements. Therefore, for this subject, several procedural alterations (session time, manipulandum, instructions, and money) were introduced before his responding conformed to rate requirements.

This study, which was originally designed to extend further the assessment dimensions of conjugate reinforcement, actually involved behavior modification. It could be said that since Subject 3's performance was not related to the independent variable as was that of his peers, he sustained a contingency deficit. He did not discern the gradual shifting of response requirements, but rather, responded irrespective of the programed contingencies. However, when several procedural alterations were attempted, he began to respond in a predictable manner and continued to respond in this fashion when the alterations were eliminated. He thus learned to discriminate the gradual increase and decrease of response requirements and performed accordingly.

Free-Operant Assessment of Musical Preference

Most attempts to assess individual preference for musical selections have required a verbal statement of preference from the subject. In such as assessment, however, it is not known whether it was the name of the stimulus as provided by the experimenter or the stimulus itself which controlled the subject's responses. Also, a post hoc assessment of preference provides limited data, since the subject is usually asked only once which he preferred. Conjugate contingencies, on the other hand, are continuously available to the subject. Therefore, preference is defined in terms of his differential rate of responding, rather than by a discrete verbal statement.

The purpose of this investigation was to assess through conjugate reinforcement certain musical preferences of two male subjects, ages 11 and 12. The subjects participated in two sessions, each of which provided a different choice between two musical selections.

To provide the most reliable preference data, the sequencing of contingencies throughout each session was individually determined. Three types of experimental conditions were scheduled. The subject could at times receive the preferred stimulus by responding at a preset rate; if he failed to respond he received the nonpreferred stimulus. At other times the contingencies were reversed; the subject could receive the preferred stimulus by not responding, whereas if he responded he received the nonpreferred selection. Finally, control segments were scheduled, in which the subject could receive only one stimulus, either the nonpreferred or the preferred selection, regardless of his responding.

The results indicated that in both sessions each subject indicated a decided preference for one stimulus over another, as defined by differential rates of responding.

Reader Preference: A Free-Operant Assessment

While previous research has assessed content and rate of presentation as two dimensions of narration, other components of the narrative process must also be experimentally analyzed. Therefore, the intent of the current study was to isolate a third variable of narration--type of reader--and conduct an analysis of subject preference.

The variable, type of reader, is not a precise dimension and cannot be assessed parametrically, as can speed of speech. Rather, it is composed of a number of speech characteristics. It was believed, however, that this preliminary focus on the broad topography of speech should be undertaken prior to a more intense analysis of other component variables.

The subjects consisted of six boys, ages 10-13, who listened to two taped versions of a story, one read by a male and the other by a female. Both versions of the story were constantly available.

Each session consisted of seven segments, which included four possible arrangements of the contingencies: (1) the male reader could be obtained by responding at a preset rate and the female by not responding; (2) the reverse of the previous arrangement, the female reader through responding and the male reader through not responding; (3) the male control, in which the male reader was the only stimulus available regardless of how the subject responded; and (4) the female control, in which the female reader was the only stimulus available regardless of subject responding.

The results revealed that only two subjects did not prefer the male reader--one indicating a preference for the female and one showing no conclusive preference for either.

Data indicative of individual preferences for any of the dimensions of narrative stimuli could be utilized in several ways. First, because of the long-lasting reinforcement effects of narration, narrative preferences could be used as consequences, whereby the subject is required to emit a certain response rate to obtain the favored narrative form. Unlike many other reinforcers, which because of satiation effects must be replaced by secondary or conditioned reinforcers to maintain behavior, contingent stories are capable of maintaining behavior for very long periods of time.

Second, this information could be used by the programer to select the most efficient stimulus mode. If some children are most reinforced by male readers who speak at a normal rate, they could be presented auditory material using such a type of reader and rate of speech. Other prosthetic settings could be arranged for those who are reinforced by speech of specific speeds, timbres, and intensities.

Third, the narrative preferences of some subjects could be so deviant that the management decision is to alter the preference. Certain individuals, for example, could be reinforced by extremely rapid or loud

speech, or narration that is syntactically garbled. Perhaps speech at normal rates, at moderate intensities, and of conventional syntax patterns is no more meaningful for these persons than background murmurs. Indeed, many of the "special education behaviors" such as poor attention span, distractibility, and hyperactivity could be the result of some subjects' failure to respond in an organized fashion to instructions. Many of these messages may not be attended to because few of the components of speech have attained a discriminative function for them.

Relationship of Sequential and Simultaneous Preference as Assessed by Conjugate Reinforcement

The purpose of this investigation was to compare the relationship of sequentially and simultaneously programed stimuli with emphasis on a determination of individual preferences. The question asked was: If a subject responded at a certain rate for one stimulus and at a higher rate for another stimulus when the stimuli were sequentially programed, would he demonstrate a concomitant preference when the same stimuli were simultaneously programed? A further concern was to compare subject rates during sequential and simultaneous conditions. Would a subject respond at a higher rate when two stimuli were simultaneously available than when only one stimulus was offered?

The subjects were eight boys, 10-14, in regular public school classes and 14 boys of the same age in special education classes. Each subject participated in two sessions. In the initial session, the subject was first offered music on increase condition, then on decrease. A similar arrangement, alternating increase and decrease conditions, was arranged for the story.

During the second session, story and music were simultaneously programed. The segments were arranged so that the subject could receive one by responding and the other by not responding, while intermediate rates of responding produced both stimuli simultaneously at moderate intensities.

Relevant to the agreement of sequential and simultaneous preference, the results indicated that six retardates responded similarly for both conditions, whereas eight showed a discrepancy. Of the normals, the sequential and simultaneous preferences were synonymous for six subjects and discrepant for two. Regarding the second concern of the study, the magnitude of difference between sequential and simultaneous responding, it was noted that four of the fourteen retardates responded more during one simultaneous segment than during either of the two sequential segments, while seven of the eight normal boys responded at higher rates when two stimuli were programed than when one stimulus was offered.

From the data of this study it appears that agreement between sequential and simultaneous preference may be one of the many social and verbal variables that indicate retarded or normal behavior, just as is the ability to match operant and verbal preferences. Regarding magnitude of response rate between sequential and simultaneous sessions, normal

behavior was associated with an increased rate of response for the preferred stimulus during simultaneous programing.

CONJUGATE CONTINGENCIES: AN AUDITORY ASSESSMENT TECHNIQUE

In a previous study (Lovitt, 1968) individual preferences for rates of speech were assessed. One story was selected and modified to attain speech rates of 90, 120, 180, 240 and 360 words per minute. Conjugate reinforcement contingencies were used to control the presentation of these auditory stimuli, whereby each subject was able to select freely and continuously his preferred rate. This method of continuous, direct measurement provided the examiner with constant data regarding each subject's performance throughout the entire investigation. The results of the study disclosed that of the ten normal subjects, five selected the "normal" 180 wpm rate, one the 120 wpm rate, and three the 240 wpm rate. Of the retardates, none selected the "normal" wpm rate. Instead, three selected the 90 wpm rate as their most preferred, two the 120 wpm rate, three the 240 wpm rate, and one the 360 wpm rate. For one retarded and one normal boy, the data were inconclusive in establishing a primary preference.

Since throughout the study two stimuli were constantly available to each subject, preference was indicated by a subject's differential rate of responding to obtain one stimulus or the other. In some instances this preference was quite conclusive--high rates of responding for one stimulus and low rates for the other. In other cases, response rates to obtain one stimulus were only slightly higher than those to acquire the alternate stimulus. It could be posited, therefore, that when preferences were not clearly indicated, the subject had failed to discrimate between stimuli. For if a subject is unable to discriminate certain aspects of one stimulus from those of another stimulus, certainly a preference cannot be made.

The above investigation of narrative rate preference not only suggested possible discrimination deficits, but raised the question of whether some subjects had a more basic deficit, that of listening. Presumably, just as certain individuals might be unable to choose one stimulus over another because of a discrimination deficit, other subjects might be unable to discriminate between stimuli because of a listening deficit.

Based on the findings of this initial study, that in some instances preferences were not clearly indicated, the current investigation was undertaken. The purposes of this research, therefore, were threefold: (1) to determine individual listening deficits, (2) to assess individual discrimination deficits, and (3) to determine individual stimulus preferences.

Subjects

Twenty-three male subjects from the Division of Child Health and the Experimental Education Unit, University of Washington, were involved in this study. The age range of the boys was from 5-10 to 14-3, while their IQ's ranged from 62 to 127. The majority of the subjects were placed at either of the two units on a temporary basis and had been referred for some academic and/or social deficit.

Apparatus

Narrative reinforcement was supplied through a Uher model 5000 tape recorder. The narrative was programed by a conjugate-reinforcement servo, model CR 2S, which converted the rate of electrical pulses from the manipulandum into changes in electrical resistance in the sound circuit. Grason-Stadler timers and pulse formers were used to program the response rate requirements. The manipulandum was a Grason-Stadler handswitch, model #800-6, while Columbia model 60036 headphones were supplied the subjects. A Gerbrands cumulative recorder was used to record each subject's response rate.

Procedures

This investigation was composed of three stages. During the first, each subject's base rate of responding was determined. The second stage was designed to assess each subject's rate of listening, while the third stage sought to determine each individual's rate of discrimination as well as his preference for rate of narration.

To determine, during the first stage, the subjects' base rates of responding, each individual was provided a handswitch that he was told to press continuously. Narration was not available to the subject during this three-minute session, regardless of his response behavior. Following this session each subject's rate of pressing was determined, then assigned to one of the six settings of the electrical timer, either 20, 30, 40, 60, 80, or 120. If, during this session, the subject responded at a rate of 15 per minute he was assigned the "20" setting. If, however, he responded initially at a rate of 46, he was assigned the "40" setting. These assigned rates were used to establish each subject's rate requirements throughout the remaining experimental sessions. Thus, the response rate requirements were individually determined and subsequently programed throughout the series of sessions.

The second stage, composed of three sessions of two segments each, was designed to determine each subject's rate of listening. During the first segment of each session, narration was contingent upon responding at or beyond the preset requirements. If, during the first stage a subject's setting was 40, he now had to respond at or beyond that rate to obtain the narration at maximum intensity. The second segment of each session was programed so that responding attenuated the narration; if the setting was at 40 and the subject responded at that rate, he could hear none of the stimulus, whereas if he did not respond at all, he received the stimulus at maximum intensity. Responding at rates

less than 40 during either segment produced the stimulus at intermediate intensities. Segment one was run for five minutes, and segment two until two consecutive minutes of no responding had occurred, but no longer than five minutes. During the first session of Stage 2, the contingent narration was a story read at 180 words per minute; whereas the story available during the second session was at a slower rate (120 wpm) and the story during the third session at a faster rate (240 wpm).

Stage 3, composed of three sessions, was designed to determine each subject's discrimination rate as well as his preference for rate of speech. While only one stimulus was available at any one time during Stage 2, two stimuli were simultaneously offered during Stage 3. Also, while the sessions during Stage 2 were composed of two segments, each session during the third stage consisted of four segments.

During the initial session of Stage 3, the two stimuli that were available to each subject were speech at 180 wpm and 240 wpm. The arrangement of these stimuli was as follows:

(1)	(2)	(3)	(4)
180 / 240	240 / 180	180 / 240	240 / 180

The number on top of the bracket indicates the <u>increase</u> condition; the subject had to respond at or beyond the preset rate to obtain that stimulus. The number on the bottom of the bracket indicates the <u>decrease</u> condition, in which the subject could obtain that stimulus by not responding. During segment one if the subject responded beyond the rate requirement, he obtained narration at 180 wpm; however, if he chose to not respond, he obtained the 240 wpm rate of speech. Segment two was a reversal of segment one; responding made available the 240 wpm rate of speech while no responding produced the narration at the 180 wpm rate. Segments three and four were replications of segments one and two. Each of these four segments was programed for five minutes; thus, each session of Stage 3 lasted for 20 minutes.

The second and third sessions of Stage 3 were the same as the first, except that during the second session the speech rates offered were 180 and 120 wpm, and during the third session they were 240 and 120 wpm.

Results

Table 1 provides each subject's initial rate of responding and the timer setting that was assigned this rate. Also included in the table are the ages and IQ's of the subjects.

Table 2 indicates each subject's deficit listening rate and deficit listening ratio for the three sessions of Stage 2. Subject listening

rates, based on individually determined response requirements, were a function of subject responding during both the increase and decrease segments. This rate was calculated by subtracting the subject's response rate during the increase segment from the response requirements and adding the subject's response rate during the decrease segment.

If, for example, a subject responded at a rate of 40 during the increase segment and 0 during the decrease segment, while his requirement was set at 40, he would have a deficit listening rate of zero (40 - 40 + 0). However, if the setting were 40 and the subject did not respond during the increase segment but responded at a rate of 40 during the decrease condition, his deficit listening rate would be 80 (40 - 0 + 40). Thus, a deficit listening rate of zero meant the subject listened to all of the narration, while a listening rate that was double the required setting indicated that the subject heard none of that stimulus. Listening rates between zero and double the required setting indicated that portions of the narrative were not heard.

Responding in excess of the preset rate requirements during the increase segment was not additionally credited, since the subject was provided the stimulus at maximum intensity whether he responded at or beyond the required rate. Deficit listening rates, therefore, never exceeded double the required rate.

For the purposes of comparing one subject with another, a listening ratio was calculated by dividing the subject's listening rate by double his response requirement setting. The lower the listening ratio, the more the subject heard the narration. The listening ratios during the first (180 wpm) session ranged from 4.2 to 52%, from 3.5 to 57.7% during the 120 wpm session, and from 1.6 to 66.5% during the 240 wpm session. The median ratios during the three sessions were 16.3, 19.3, and 25.4. When each subject's lowest listening ratio throughout the three sessions was established, it was discovered that for seven individuals the lowest ratio occurred during the 180 wpm session; for seven, during the 240 wpm session; and for nine, during the 120 wpm session. Furthermore, when each subject's median listening ratio was derived, it was discovered that 15 had ratios of from 0 to 25%, seven from 26 to 50%, one from 51 to 75 %, and none from 76 to 100%.

Table 3 presents data from Stage 3 of the investigation, the discrimination phase. Discrimination rates and ratios were based on each subject's rate of responding during the latter two segments of each discrimination session. When, for example, the 180 wpm narration was programed as the increase stimulus during segment three but presented as a decrease stimulus during segment four, the subject had to alternate responding from one segment to another in order to discriminate perfectly throughout both segments. If, when the subject's required rate was 40, he responded at a rate of 40 or beyond during one of the latter two segments but emitted no responses during the alternate segment, he was discriminating perfectly between the two stimuli. He continuously obtained only a single stimulus--responding to obtain it when programed on increase and not responding when programed on decrease.

The initial step in calculating each subject's deficit discrimination rate was to determine his rates of responding during segments three and four of each session. The subject's highest rate was then subtracted from the rate requirement and added to his lowest rate of responding to obtain his deficit discrimination rate. In the example above, where the subject's highest rate was 40 and his lowest 0 while his requirement was 40, he would have had a deficit of 0 (40 - 40 + 0).

Moreover, if a subject's highest rate was 40 and he responded during both segments at a rate of 40, his deficit rate would be 40 (40 - 40 + 40). Similarly, if a subject did not respond during either segment and his required rate was 40, he too would have a deficit rate of 40 (40 - 0 + 0). In both cases, the subjects would have totally failed to discriminate between the two stimuli, since their deficit discrimination rates equaled their rate requirement. These two subjects would have heard one stimulus during one segment and the other stimulus during the next segment.

Deficit discrimination rates were only individually relevant since they were derived from each subject's required response rate. Therefore, deficit discrimination ratios were calculated by dividing the subject's discrimination rate by his rate requirement. The ranges of deficit discrimination ratios during the three sessions of Stage 3 were extremely large, from 2 to 100% when the 180 and 240 wpm rates were paired, from 2 to 100% when 180 and 120 wpm rates were offered, and from 1.6 to 100% when 120 and 240 wpm rates were offered. In other words, some subjects (those with low ratios) demonstrated an ability to discriminate between stimuli; others (those with high ratios) were unable to discriminate; and some (those with median ratios) were partially able to discriminate.

When each subject's lowest discrimination ratio throughout the three sessions was determined, it was revealed that the low ratio occurred for five subjects during the first session (180 and 240 wpm); for four subjects, during the second session (180 and 120 wpm); and for ten subjects, during the third session (120 and 240 wpm). Thus, more subjects were able to discriminate when the difference between stimuli (words per minute) was most pronounced. When each subject's median discrimination ratio was plotted, it was revealed that eight subjects had ratios from 0 to 25%, one from 26 to 50%, two from 51 to 75%, and nine from 76 to 100%.

Individual preferences from the three sessions of Stage 3 were determined by differential rate of responding. If during the first session the subject responded more to obtain the 180 wpm narration than to acquire the 240 wpm one, a preference for 180 wpm was indicated. Accordingly, if during the second session the subject responded more for the 180 wpm version than for the 120 wpm option, the former rate was his preference. And, if during the third session the subject responded more for the 240 wpm narration than for the 120 wpm tape, the former was his preferred narrative rate. Thus, this subject's primary preference was for speech at 180 wpm, since he chose that rate over both the 240 and 120 wpm versions. Table 4 indicates the subjects' preferences for each session of Stage 3 and their primary preferences.

Data available from 19 of the 23 subjects during session one indicated that 12 preferred the 240 wpm version to the 180 wpm rate of speech, while seven chose the slower, 180 wpm speed. During the second session, when the 180 and 120 wpm stories were offered, 10 subjects preferred the slower version and nine the faster. One subject selected neither. When the 120 and 240 wpm rates were simultaneously offered, six chose the 120 wpm rate, 12 selected the faster option, and one subject chose neither. For five subjects a primary preference was established for speech at 120 wpm. Five others selected the 180 wpm rate and eight the 240 wpm rate as their primary preference.

Discussion

The skills of listening, discriminating between auditory stimuli, and demonstrating preference for one auditory stimulus over another are behaviors basic to much learning. Certainly, if an individual cannot attend to auditory stimulation, i.e., is not aware of the sounds in his environment, no learning via the auditory channel can possibly take place. Furthermore, unless a subject is able to discriminate the many sounds he is exposed to, few if any complex behaviors requiring differential responding will be acquired. Finally, unless a wide variety of preferences for particular types or forms of narrative stimuli are developed, the world of communication and dialog will hold little meaning.

Traditionally, when listening, discrimination, and preference are assessed, the subject is asked to respond to some stimulus. Listening, for example, is often assessed by comprehension. A story is read to the subject who is then required to answer questions pertaining to its content. Presumably, if he was able to answer the questions, he was a good listener; if not, he was a poor listener. Auditory discrimination is often evaluated in much the same way. Two or more sounds are presented to the individual and he is then required to respond differentially to a number of parameters, such as length, intensity, timbre, or pitch. To establish a subject's ability to discriminate, he could be required to specify which sound was the longest, loudest, shrillest, or highest. Similarly, in assessing preference for one auditory form or another, the subject is often required to respond differentially following the presentation of a set of auditory stimuli. A series of musical compositions could be played one after another, with the subject then being asked to specify his choice.

In all of these instances requiring the individual to respond to a stimulus, only discrete measures of the behavior are obtained. When listening is assessed by a set of comprehension questions, only as many discrete measures are obtained as there are questions. In certain instances an individual could listen at some times and not at others, and as a result be unable to answer the question. Or the subject could not listen at all, but still respond appropriately to the questions because of past literary exposure. Correspondingly, when discriminative or preference behaviors are evaluated by obtaining a series of discrete

evaluations following the presentation of a set of stimuli, these assessments could be invalid impressions of the subject's abilities.

By using conjugate contingencies to evaluate the processes of listening, discrimination, and stimulus preference, examiners are provided with a far more valid index of behavior. For while the preceding techniques recorded subject responding to a set of stimuli, conjugate assessment records subject responding to obtain a consequence (Mira, 1968).

A second major difference between the traditional method of auditory assessment and the conjugate method is that during the former a discrete record of behavior is obtained, whereas during the latter a continuous record of behavior is provided. This ongoing assessment is possible because the subject is an active participant rather than a passive consumer; the availability of the programed auditory stimulation is a direct function of his behavior. Further, the subject is always informed as to his own behavior; for the programed stimulus is continuously altered as a function of his performance. Meanwhile, as the subject is continuously provided feedback regarding his responding, the examiner is reciprocally provided a continuous graphic display of the subject's performance.

The assessment of these skills, important as it is, is a mere beginning, however. For unless remediation plans accompany diagnostic precision, the function of such assessments is questionable. When deficits in listening, discrimination, or stimulus preference have been noted and their extent ascertained, the manager must institute remediation efforts to alter certain behaviors. He must, furthermore, evaluate the function of his efforts on subject performance.

The indices that were formulated for this research--the deficit listening and discrimination rates and ratios--should assist managers to affect subject responding to auditory material. First, they will enable programers and rehabilitation specialists to quantify a subject's deficit and secondly, will enable the behavior manager to readily determine the effectiveness of his remediation attempts. By using such a measurement system, rehabilitation specialists will be able to determine precisely behavioral change and/or program effectiveness.

References

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Mira, M. Auditory assessment of children from a psychologist's point of view. Paper read at Council for Exceptional Children Convention, New York, April, 1968.

Table 1

Individual Descriptive Data

Subject	Base Rate	Time Setting	Age	IQ
S^1	56	60	9-0	87 #
S^2	76	80	14-3	66
S^3	72	80	13-11	95
S^4	195	120	12-2	96
S^5	130	120	12-10	62
S^6	46	40	9-2	75
S^7	83	80	11-1	*
S^8	88	80	10-11	*
S^9	110	120	9-11	*
S^{10}	100	120	9-0	*
S^{11}	31	40	9-1	*
S^{12}	202	120	11-1	*
S^{13}	66	60	10-2	67
S^{14}	85	80	10-6	*
S^{15}	114	120	11-4	120
S^{16}	120	120	9-7	91
S^{17}	112	120	12-6	110
S^{18}	113	120	9-4	85
S^{19}	134	120	9-8	*
S^{20}	120	120	7-7	127 (Peabody)
S^{21}	92	80	10-1	96
S^{22}	105	120	7-9	93
S^{23}	81	80	5-10	111

IQ scores are WISC full scale unless otherwise noted.

* No data available.

Table 2

Deficit Listening Rates and Ratios During Three Experimental Sessions

Subject	Session I 180		Session II 120		Session III 240	
	Rate	Ratio	Rate	Ratio	Rate	Ratio
S^1	22.4	18.0	13.8	11.5	25.6	21.3
S^2	25.7	16.0	92.7	57.7	70.4	44.0
S^3	7.3	4.5	5.6	3.5	44.1	27.8
S^4	30.4	12.6	67.2	28.0	73.5	30.6
S^5	20.8	8.7	20.5	8.5	31.4	12.7
S^6	25.4	31.8	17.6	22.0	20.4	25.4
S^7	7.3	4.5	68.5	42.8	78.0	48.7
S^8	56.0	35.0	71.4	44.5	100.6	66.5
S^9	17.1	7.1	1[illegible].2	5.5	66.2	27.6
S^{10}	44.8	18.7	46.3	19.3	71.9	29.9
S^{11}	14.8	18.5	15.3	18.9	1.3	1.6
S^{12}	30.9	16.3	46.3	19.3	104.9	43.5
S^{13}	22.7	18.9	25.1	20.4	38.3	32.0
S^{14}	80.8	51.0	53.8	33.8	54.4	34.0
S^{15}	36.8	15.4	45.6	19.6	26.9	11.2
S^{16}	46.3	19.3	21.8	8.8	15.2	6.3
S^{17}	10.0	4.2	48.0	20.0	20.0	8.3
S^{18}	47.2	19.3	38.9	16.2	28.6	11.9
S^{19}	29.8	12.4	38.4	16.0	28.0	11.6
S^{20}	112.4	52.0	83.2	16.0	28.0	11.6
S^{21}	14.4	9.0	8.0	5.0	13.6	8.5
S^{22}	34.0	14.2	31.8	12.8	24.0	10.0
S^{23}	30.4	19.0	44.0	27.8	46.4	29.0

Table 3

Deficit Discrimination Rates and Ratios in Three Experimental Sessions

Subject	Session I 180 or 240		Session II 180 or 120		Session III 120 or 240	
	Rate	Ratio	Rate	Ratio	Rate	Ratio
S^1	60.0	100.0	60.0	100.0	3.6	6.0
S^2	53.4	66.0	63.2	79.0	10.0	12.5
S^3	2.0	2.5	4.6	5.7	0.0	0.0
S^4	*	*	*	*	*	*
S^5	6.0	5.0	12.0	10.0	2.0	1.7
S^6	38.8	97.0	39.4	98.5	37.2	93.0
S^7	*	*	*	*	*	*
S^8	61.2	76.5	75.8	95.0	77.8	96.5
S^9	84.1	70.0	20.0	16.7	52.8	44.0
S^{10}	93.2	77.4	97.0	81.0	105.2	88.0
S^{11}	5.8	14.5	3.6	9.0	32.0	80.0
S^{12}	13.0	10.8	15.2	12.5	28.8	24.0
S^{13}	28.8	48.0	47.4	79.0	*	*
S^{14}	80.0	100.0	79.6	99.5	78.0	97.5
S^{15}	31.2	26.0	2.4	2.0	2.0	1.7
S^{16}	112.8	94.0	18.4	5.3	120.0	100.0
S^{17}	10.4	11.7	16.8	14.0	4.8	4.0
S^{18}	116.8	97.5	120.0	100.0	110.0	98.5
S^{19}	2.4	2.0	4.8	4.0	108.0	90.0
S^{20}	*	*	*	*	*	*
S^{21}	77.7	96.5	61.6	77.0	60.8	76.0
S^{22}	21.6	17.9	25.6	22.2	16.0	13.3
S^{23}	77.0	96.5	66.8	83.5	80.0	100.0

* No data available.

Table 4

Individual Narrative Rate Preferences

Subject	Session I 180 or 240	Session II 180 or 120	Session III 120 or 240	Primary Preference
S^1	180	180	240	180
S^2	240	120	120	120
S^3	240	120	240	240
S^4	*	*	*	*
S^5	240	180	240	240
S^6	240	180	240	240
S^7	*	*	*	*
S^8	240	120	120	120
S^9	240	120	120	120
S^{10}	180	180	120	180
S^{11}	240	120	240	240
S^{12}	240	180	240	240
S^{13}	240	120	*	*
S^{14}	*	180	240	*
S^{15}	180	180	240	180
S^{16}	180	180	equal	180
S^{17}	240	120	240	240
S^{18}	240	equal	240	240
S^{19}	180	180	240	180
S^{20}	*	*	*	*
S^{21}	180	120	120	120
S^{22}	240	120	240	240
S^{23}	180	120	120	120

*No data available.

RESPONSE RATE AS A FUNCTION OF INCREASING AND DECREASING CONJUGATE REINFORCEMENT REQUIREMENTS

Several complex behaviors have been assessed by conjugate reinforcement. Lindsley in a number of early investigations found conjugate contingencies to be a sensitive measure of such independent variables as electroshock and depth of sleep (1962, 1957). Nathan later reported that conjugate schedules provided a sensitive measure of such communication variables as transmitting and receiving (1964, 1965). In more recent inquiries, Lovitt demonstrated that conjugate reinforcement was a suitable contingency to assess such narrative variables as music, rate of speech, and children's literature (1968a, b, c: 1967).

The sensitivity of the conjugate schedule is largely the result of the fact that subject responding directly controls the intensity of the reinforcing stimulus. The reciprocal of this contingency relationship, however, is equally important; for the stimulus intensity also controls the subject's responses.

The present experiment was designed to probe further the use of conjugate contingencies to assess behavior. Specifically, the purpose at this time was to determine the function of steadily increasing and decreasing response requirements on rate of responding.

Method

Subjects

Subjects were three experimentally sophisticated boys. All were members of a class at the Experimental Education Unit of the University of Washington. All subjects had participated in several hours of conjugate research prior to the current study--S1, age 10, and S3, age 13, for 10 hours each; and S2, also age 10, for 14 hours.

Apparatus

Narrative reinforcement was supplied through either a Wollensak model T-1500, or a Uher model 5000 tape recorder. This narration was programed by a conjugate-reinforcement servo, model CR2S, which converted the rate of electrical pulses from the manipulandum into changes in electrical resistance in the sound circuit. Grason-Stadler timers and pulse formers were used to program the response rate requirements. The manipulandum was either a Grason-Stadler hand switch, model #800-6, or a Lindsley manipulandum. Columbia, model 60036, headphones were provided the subjects, and a Gerbrands cumulative recorder was used to record each subject's response rate.

Procedure

Subjects were placed in a small experimental room, and were provided a set of headphones and a microswitch. They were told that they could press the switch if they wished to do so, but were not given other information as to the experimental contingencies--whether they had to press or if so at what rate. Throughout the several experimental sessions, the contingent narration provided to S1 and S2 was Rudyard Kipling's Just So Stories, while S3 was offered Alfred Hitchcock's Ghost Stories.

Each session was composed of two episodes, in the first of which the response requirements were steadily increased, and the second, where response requirements were steadily decreased. During the increase episode the initial requirements were set at 20 responses per minute. At this time if the subject responded at, or beyond, this required rate he was granted the stimulus at its fullest, preset, intensity. However, if he did not respond he obtained none of the stimulus. Response rates less than 20 granted the stimulus at correspondingly lesser intensities. As subject responding fell below the minimal requirements the stimulus intensity accordingly attenuated. However, as response rate accelerated and approached the required setting, the intensity of the stimulus proportionately increased. The availability of the stimulus, then, was not an on-or-off proposition, but gradually diminished and reappeared in direct relationship to the subject's behavior.

Following the four minute segment that required a response rate of 20, the requirements were set at 30. Four more segments comprised this episode, with requirements later set at 40, 60, 80, and 120 responses per minute. Each of the six segments in this increase episode was programed for four minutes. That same day or no later than the next day, the second episode of the session was run. Now the response rate requirements were programed in reverse order. The episode began at the 120 setting, then decreased to 80, 60, 40, 30, and finally, 20 responses per minute.

Seven such sessions consisting of increasing and decreasing the response requirements were run for S1, four for S2, and six for S3.

Results and Discussion

S1. On the first session this subject's rate of response bore a direct relationship to the independent variable, increasing or decreasing response requirements. Although this subject consistently responded beneath the required rate throughout seven experimental sessions, his behavior remained directly related to the independent variable. It was noted, furthermore, that S1 consistently responded at a slightly higher rate during the decreasing episode than during the increasing phase. Figure 1, indicating mean and range response rates, is a summary graph of S1's performance in seven experimental sessions.

S2. This subject responded in a manner similar to S1, in that from the first session his behavior was directly related to the increasing and decreasing rate requirements. Although the two subjects were similar in this respect, they did differ in terms of variability and response frequency. S2 generally responded less than S1, but his performance from session to session was less variable. In fact, as is illustrated in Figure 2, this subject showed almost no variability throughout all sessions when the lower response requirements (20, 30, and 40) were in effect. Furthermore, as with S1, S2's response rates during the decreasing episode were not higher than when increasing responses were required.

S3. Throughout the six sessions that were programed for this subject, little systematic relationship was demonstrated between the subject's response rate and either the increase or the decrease conditions. For the most part S3 consistently overresponded, particularly during the decreasing episode. His mean response rate for all experimental conditions was about 100 responses per minute. S3's variability was, furthermore, much greater than that of either S1 or S2. S3's response rate matched the imposed rate requirements only during those times that the response requirements were set at 120 responses per minute. During the lesser settings, the subject infrequently experienced the fact that he was responding needlessly. Since he seldom experienced the gradual fading of the stimulus as a function of responding below the rate requirements he was thus unable to discern the fact that less effort was required to be granted the stimulus at full intensity. It could be said that S3 was always behaving on an avoidance schedule, never escaping the "aversive" incomplete or totally absent stimulus. Figure 3 is a summary graph of S3's performance throughout six experimental sessions.

Because S3's rate of response showed little relationship to the independent variable (increased or decreased response requirements), further explorations were undertaken to discover the reason for his unpredictable performance.

Three additional sessions were therefore programed for S3, the procedural difference being the length of each segment. Whereas during the initial sessions each segment during both increase and decrease episodes was scheduled for four minutes, each now was scheduled for five minutes. As indicated by the summary figure, Figure 4, S3's responding was somewhat more related to response requirements than during the initial sessions as for the most part his rates diminished as the requirements were lessened and rose as response requirements were increased. His variability throughout these latter sessions was somewhat less than that evidenced during the six initial sessions. S3's rate of response, however, during the segments that required minimal responding--40, 30, and 20--continued to be well above the required rates.

A further procedural alteration was then initiated in an attempt to relate S3's pattern of responding to the independent variable. The manipulandum was changed from the hand switch, which required little

response effort, to a Lindsley manipulandum which was adjusted to require 3-3/4 pounds of pressure per pull. Three sessions were run with this altered apparatus. As is indicated by Figure 5, S3's responding was now directly related to the response requirements during the increasing episode; but he demonstrated a contrary pattern during the decreasing episodes, since his responding accelerated while the requirements were reduced. It can be further noted that S3's overall rate of response during these sessions, when compared to his prior performance, was reduced, as is illustrated by Figures 3 or 4. Also, his variability was similarly reduced, particularly during the increased requirement episode.

Owing to the fact that reversibility was yet to be achieved with S3, a third alteration was attempted. One further procedural change was added to the two previously mentioned--increased time per segment as well as the use of a different manipulandum. Instructions were now given the subject: "Try to hear all of the story, but don't respond any more than is necessary." The subject was furthermore told that if he could do this, the experimenter would enter his room periodically and give him two cents.

To satisfy this new contingency, the experimenter obtained a rate calculation for the first segment on the increasing episode (20 required responses). If the subject responded at a higher rate during the next segment, the experimenter entered the room and gave him two cents. Gradual response increases from segment to segment were evident after the introduction of this contingency. An opposite contingency was in effect throughout the decreasing episode. The initial rate calculation was now made after the first decreasing segment (120 responses per minute), and subsequently, lesser and lesser rates were associated with the two cents. Figure 6 illustrates S3's performance during the first of two sessions employing the use of instruction and periodic money. As is noted in the figure, S3 now responded in accord with the independent variable. Although his rates were generally below the response requirements, his responding increased and decreased as the response requirements were raised and lowered. S3's performance on the second session with these same contingencies indicated a similar relationship with the imposed variable.

Since the S's behavior now finally corresponded with the assigned variable, the experimenter's strategy was to remove as many of the procedures as possible that had been imposed since the initial phase of the study.

Subsequently, during the next session, the E did not enter the experimental room after each segment, but instead told the S before the session, "If you do a good job, I'll give you a dime." This contingency was specified prior to both the increasing and decreasing episodes. S3 continued to behave in a predictable manner during this contingency--increasing his rate of responding as the requirements were raised and diminishing his rate as the requirements were lowered.

On the basis of S3's performance on these past three sessions, it

was decided to eliminate the instructions and to change the manipulandum from the Lindsley plunger to the original microswitch. During this session, which employed the six five-minute segments of the increasing and the decreasing episodes, the S continued to behave in a predictable manner. During all segments where the response requirement was raised, S3 correspondingly increased his responding, while his rates of response decreased as the required rates were steadily lessened.

A final session then was run, employing the exact conditions of the first session of the experiment--four-minute increasing and decreasing segments, no instructions, no money contingencies, and use of the microswitch manipulandum. S3's performance at this time was directly related to the increasing and decreasing response requirements. Figure 7 illustrates the S's mean response rate during the increasing and decreasing episode of the last session. For purposes of comparison, S3's initial record is also presented. The figure, then, indicates the S's performance before and after training.

Seventeen sessions were run with S3 between the first session, where the S's responding did not relate to the independent variable, and the final session, where he did respond in a predictable manner. During this time four procedural changes (session time, manipulandum, instruction, and money) were introduced and withdrawn in an effort to arrange conditions whereby the S's responding could be controlled.

This study, which was originally designed to extend further the assessment dimensions of conjugate reinforcement, actually involved behavioral modification. It could be said that since S3's performance was not related to the independent variable as was that of his peers, S1 and S2, he sustained a <u>contingency deficit</u>. He did not discern the gradual shifting of response requirements, but rather, responded irrespective of the programed contingencies. However, when several procedural alterations were attempted, he did respond in a predictable manner and furthermore, continued to respond in a like fashion when the alterations were eliminated. He thus learned to discriminate the gradual increase and decrease of response requirements and performed accordingly.

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Fig. 1. Summary graph of S1's performance during increasing and decreasing episodes for seven experimental sessions.

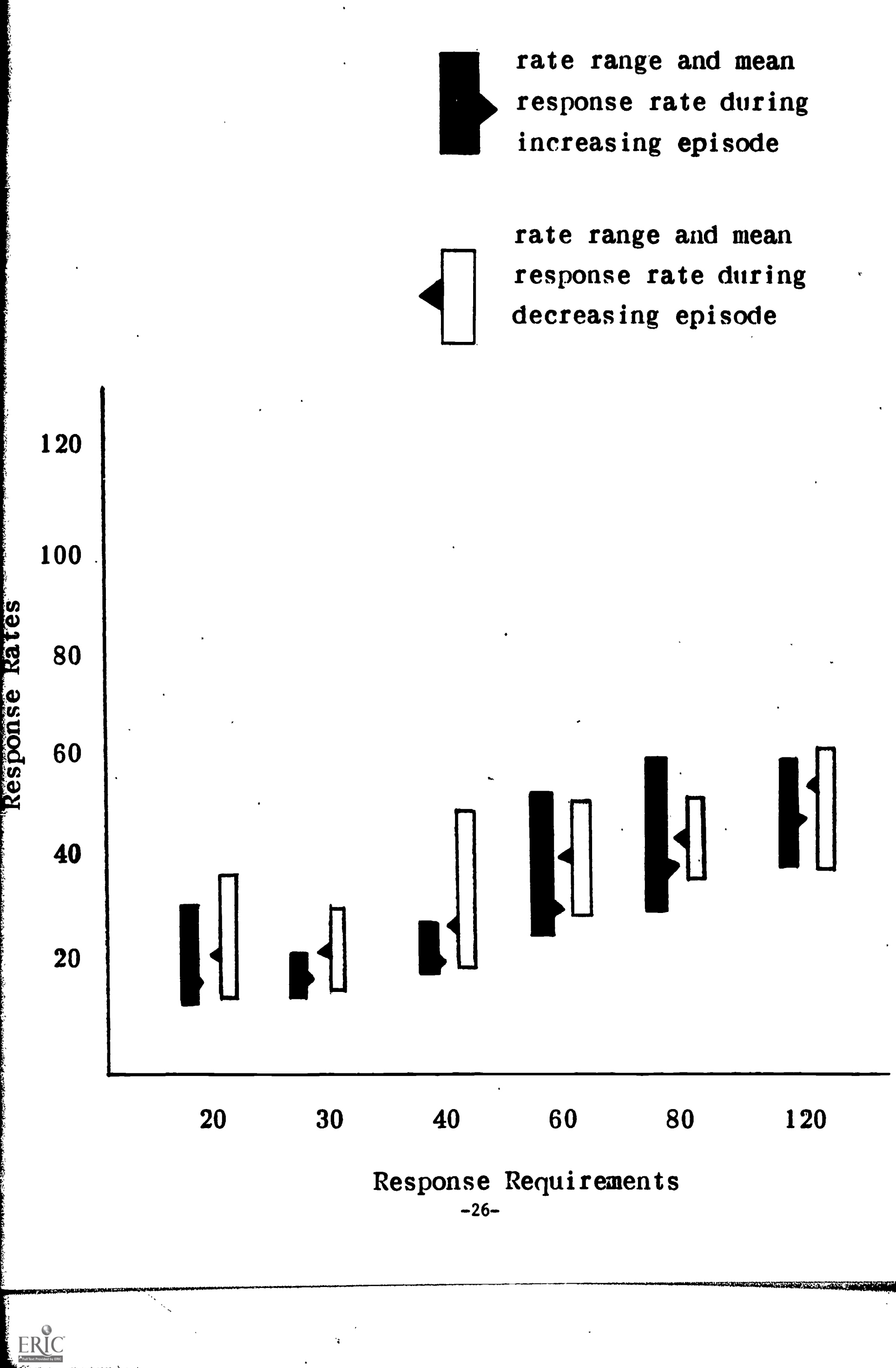

rate range and mean response rate during increasing episode
rate range and mean response rate during decreasing episode
Response Rates
120
100
80
60
40
20
20
30
40
60
80
120
Response Requirements

Fig. 2. Summary graph of S2's performance during increasing and decreasing episodes for four experimental sessions.

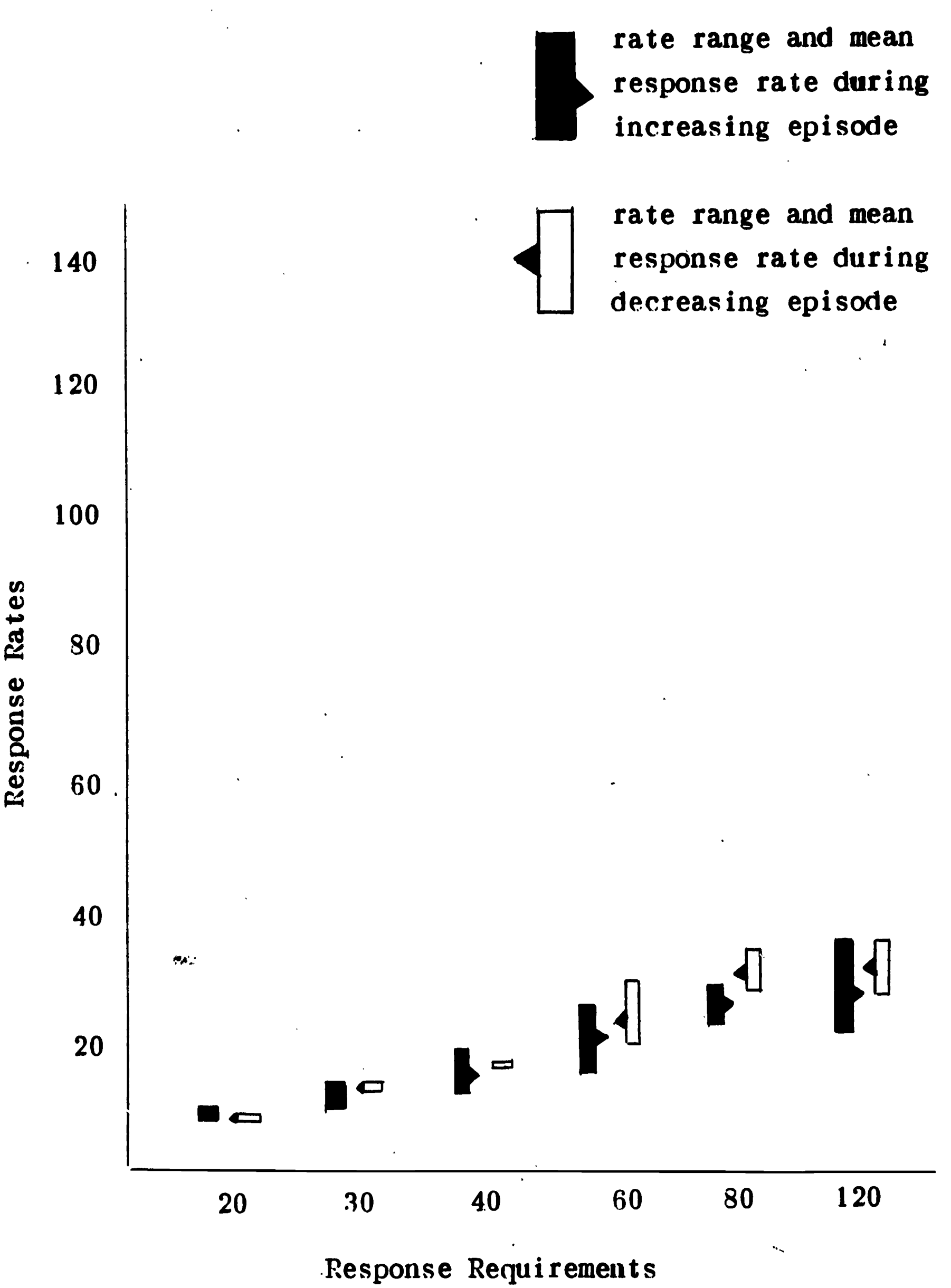

rate range and mean response rate during increasing episode
rate range and mean response rate during decreasing episode
Response Rates
140
120
100
80
60
40
20
20
30
40
60
80
120
Response Requirements

Fig. 3. Summary graph of S3's performance during increasing and decreasing episodes for six experimental sessions.

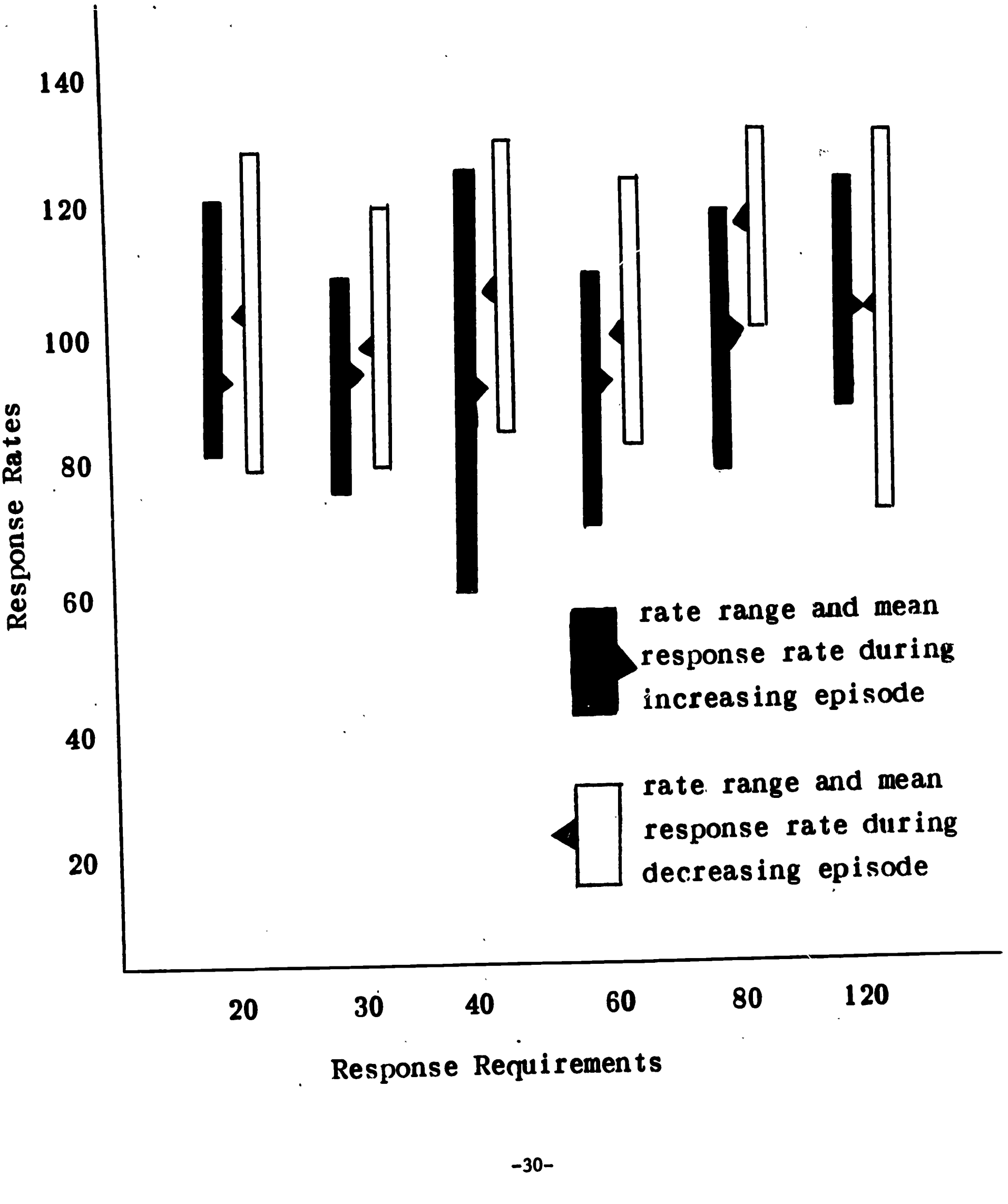

Response Rates
140
120
100
80
60
40
20
rate range and mean response rate during increasing episode
rate range and mean response rate during decreasing episode
20
30
40
60
80
120
Response Requirements

Fig. 4. Summary graph of S3's performance for three sessions when each segment lasted five minutes.

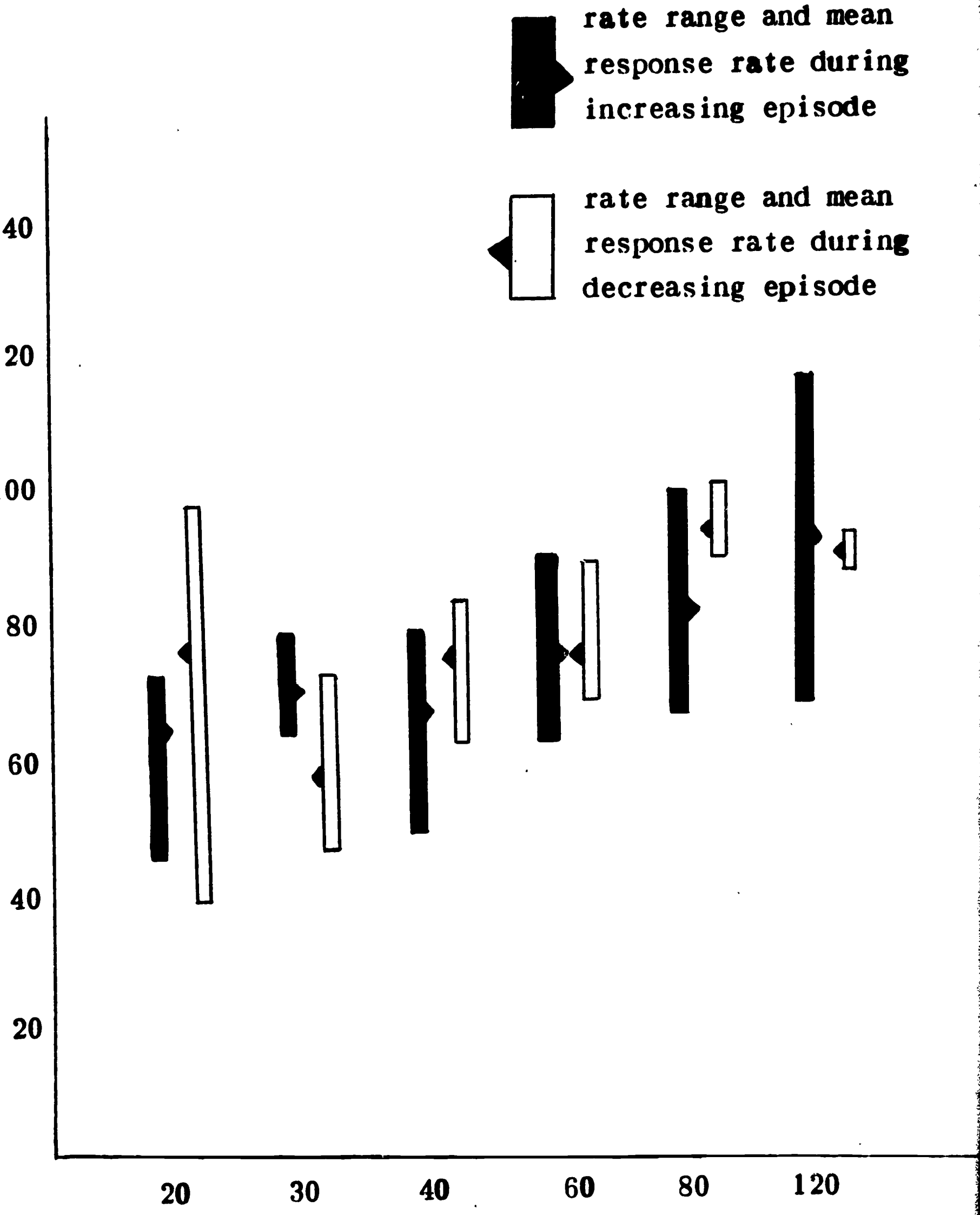

rate range and mean response rate during increasing episode
rate range and mean response rate during decreasing episode
Response Rates
140
120
100
80
60
40
20
20
30
40
60
80
120
Response Requirements

Fig. 5. Summary graph of S3's performance for three sessions with the Lindsley manipulandum.

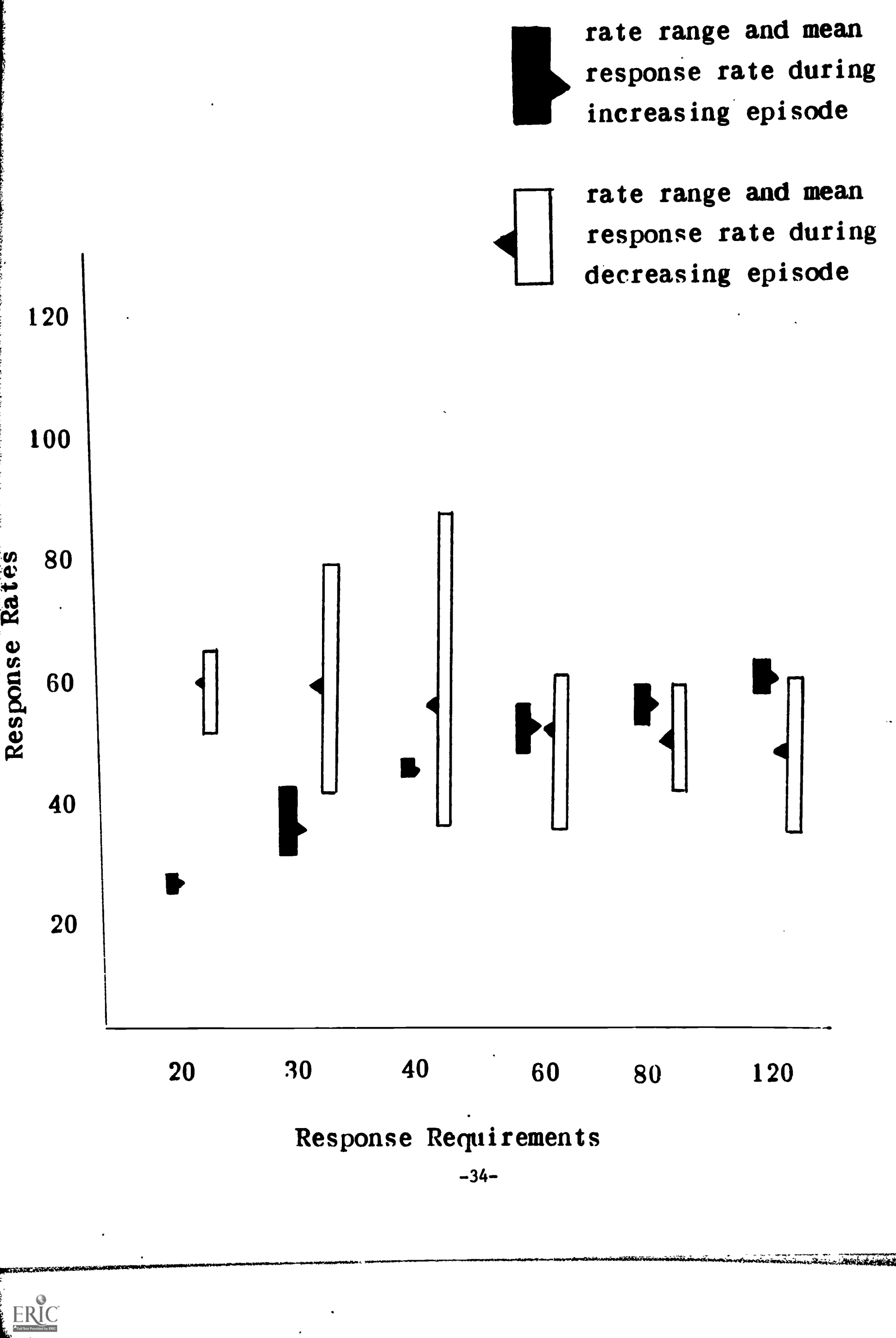

rate range and mean response rate during increasing episode
rate range and mean response rate during decreasing episode
Response Rates
120
100
80
60
40
20
20
30
40
60
80
120
Response Requirements

Fig. 6. S3's performance when the ten-cent contingency was added.

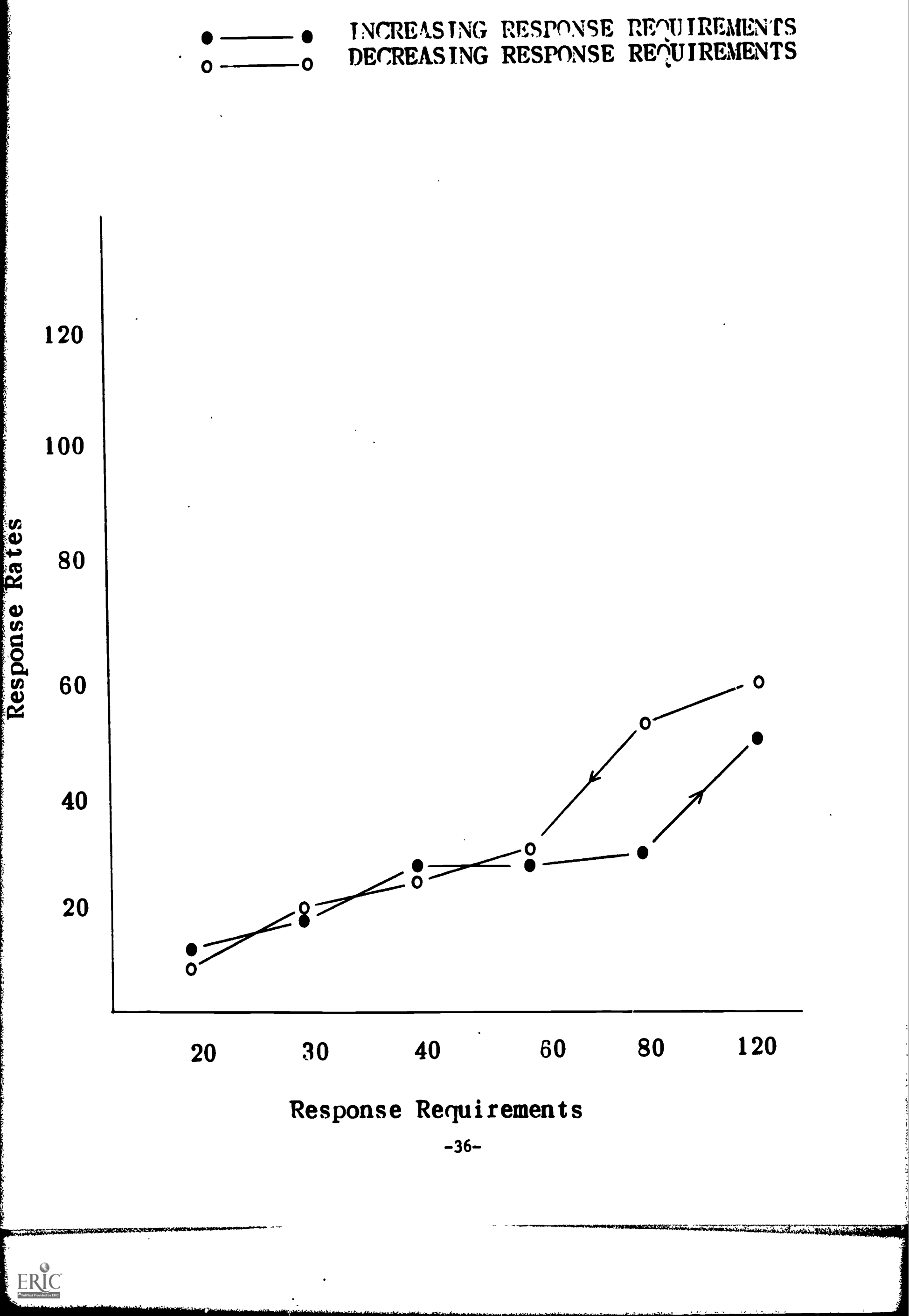
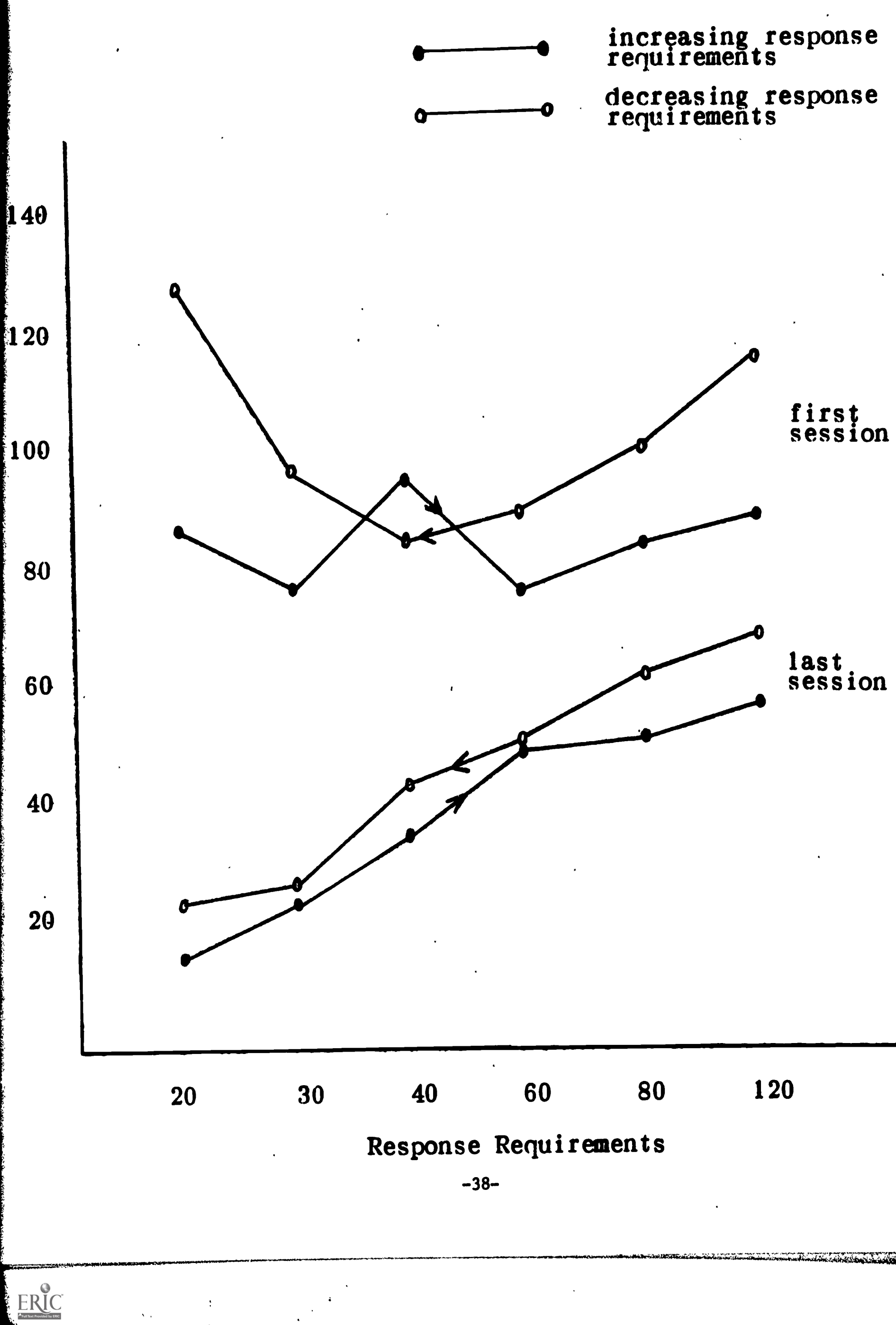

INCREASING RESPONSE REQUIREMENTS
DECREASING RESPONSE REQUIREMENTS
Response Rates
120
100
80
60
40
20
20
30
40
60
80
120
Response Requirements

Fig. 7. S3's performance on the initial and final experimental sessions. The same procedures were in effect during both sessions.


increasing response requirements
decreasing response requirements
140
120
100
80
60
40
20
first session
last session
20
30
40
60
80
120
Response Requirements

FREE-OPERANT ASSESSMENT OF MUSICAL PREFERENCE

If preference as a motivational component is defined as one specific selection from a set of two or more mutually exclusive stimuli, then musical preference may be indicated by a choice of listening to one musical selection in lieu of another. Most attempts to assess individual preferences for various types of music have necessitated a verbal response from the subject. The subject either is asked which musical stimulus he would prefer if several were available, or is allowed to listen to several musical stimuli and then asked to make a choice.

Essentially, two problems are involved in a method which assesses individual preference by eliciting a verbal response from the subject. First, when a choice is made, following a request for a preference, it is unknown whether it was the name of the stimulus, as provided by the experimenter, or the stimulus itself which controlled the subject's response. Second, a post hoc assessment of preference provides limited quantifiable data as to the strength of this preference, since the subject is usually asked only once which stimulus he preferred. Although a number of such trials or sessions could be arranged, this process would consume a great amount of time.

A recent development of a highly sensitive contingency--conjugate reinforcement--has been employed to assess individual preferences. During conjugate schedules the stimulus is always available; its intensity, however, is a direct and continuous function of the response behavior of the subject. This contingency, then is particularly suitable for the analysis of preference for complex stimuli--visual or auditory--that cannot be offered in an episodic manner without considerable loss of reinforcing value.

By employing conjugate contingencies to assess preference, investigators have been able to overcome, essentially, the aforementioned procedural difficulties. Morgan and Lindsley (1966) provided experimental evidence relevant to the first problem--the effects of the experimenter on subject preference. In this study, a comparison was made of verbal and operant preference for stereophonic or monophonic music. Their research demonstrated that although stereophonic music was discriminated from and verbally preferred to monophonic music by all four adult subjects, stereophonic music was operantly preferred by only two subjects. They concluded that two stimuli which can be discriminated, and for which subjects verbally indicate differential preference, do not necessarily have differential reinforcing powers.

The second problem of some preference methods--obtaining quantifiable data regarding subject preference--is also largely overcome by using

conjugate contingencies. Since the subject's response rate is not restricted by trials or other experimental restraints in a free-operant situation, preference can be defined in terms of differential response rate. It is not uncommon during a 10 minute free-operant session for a subject to make as many as 1,000 preference responses. To obtain a similar number of indications of preference, in settings that require the stimulus be "consumed" before a preference be obtained, would be an expensive pursuit.

In a series of recent studies, conjugate reinforcement has been employed to assess preference for certain verbal narrations. In an investigation designed to assess the relative reinforcing effects of five classes of verbal narration (Lovitt, 1967a), the stimuli were programed sequentially. Differential preference was determined by analyzing each subject's response rate to obtain each narrative form. In a second study (Lovitt, 1967b), two recorded stories were simultaneously presented to several subjects. Since the subject could continuously select the story of his choice, a moment-to-moment record of his "interest" was obtained. Conjugate reinforcement was further used (Lovitt, 1968) to compare sequential and simultaneous preferences of retarded and normal males. The concern of this study was to determine the relationship between subject preference when two stimuli were programed sequentially and when the same stimuli were offered simultaneously.

The purpose of the current investigation was to assess through conjugate reinforcement certain musical preferences of two preteenage boys.

Procedure

Subjects

Subject 1 was a 12-year-old who attended a special class at the Experimental Education Unit, University of Washington. Subject 2 was an 11-year-old who attended a regular sixth-grade class in Kirkland, Washington.

Method

The subject was seated in an experimental room and provided with a headset and a hand microswitch. He was told he would be listening to music, but was not instructed as to the reinforcement contingencies--whether he had to press the switch or, if so, at what rate.

The subjects were involved in two experimental sessions each lasting from 20 to 30 minutes. During the first session Subject 1 was provided with the option of listening to either a Glazounov Symphony (G) or the musical play West Side Story (W). His choices during the second session were between the Tiajuana Brass (T), and Petula Clark (P). Subject 2's options during the first session were Tiajuana Brass and West Side Story and throughout the second session, Glazounov and Petula Clark.

Each experimental session comprised from five to eight experimental segments. The contingencies from segment to segment were not prearranged.

but were dictated by the subject's ongoing response behavior. The experimenter arranged the contingencies of each segment in such a way as to obtain data as reliable as possible regarding the subject's preference.

The letters G, W, T, or P, when on top of the symbol (see Figs. 1 and 2), indicate that a subject must respond at or beyond 120 responses per minute to obtain that stimulus. Letters on the bottom of the symbol signify that the subject must not respond in order to acquire that stimulus. If a subject responds at rates less than 120, he is provided portions of both stimuli.

During some segments the same letter appears on both the top and bottom of the symbol. At these times the subject has no option; he receives the stimulus regardless of responding or not responding. These control segments serve two functions, depending upon the sequence of their appearance. First, a control situation composed of the stimulus that had been previously chosen following a segment where the preferred stimulus was contingent upon responding serves to indicate a subject's avoidance extinction rate. If a subject responds to <u>acquire</u> a certain stimulus he is also responding to <u>avoid</u> another stimulus. Therefore, those responses emitted by the subject when the "aversive stimulus" had been removed and only the favored stimulus is obtainable indicate his rate of avoidance extinction.

Second, additional data are obtained when a control segment composed of the nonfavored stimulus is programed preceding a segment where the subject must respond to obtain the preferred stimulus. During this arrangement of contingencies the control segment is programed until the subject ceases responding for at least 30 seconds. Following this 30-second response lapse, the contingencies are altered so that, to acquire the previously preferred stimulus and not the non-preferred stimulus, responding is necessary. Since the subject has not responded during the control (no option) segment for 30 seconds, but during the following (option) segment can obtain his favored stimulus, an index of his ability to adapt to a contingency shift is obtained.

Apparatus

The musical selections were programed through a conjugate-reinforcement-servo which converted the rate of electrical pulses from the hand-switches into changes in electrical resistance in the sound circuit. The rate of responding required to maintain maximum volume (which was preset at a comfortable level) was pre-experimentally determined as 120 responses per minute for both subjects. A cumulative recorder that registered each subject's response rate, two tape recorders, and the automatic programing apparatus were located in an adjoining room.

The tapes of the two musical selections were continuously in motion. Except for the control segments specified above, it was possible for the subject to switch back and forth freely between one musical selection and the other.

RESULTS AND DISCUSSION

Figure 1 is a graphic indication of Subject 1's musical preference. The top portion of the figure represents his preference for West Side Story (W) over the Glazounov Symphony (G) while the lower portion of the figure identifies his preference for the Tiajuana Brass (T) over Petula Clark (P).

Segment one of the first session indicated that, although Subject 1 initially responded at a high rate to acquire G, he soon ceased responding and was granted W. When the contingencies were reversed during segment two, Subject 1 continued to prefer W, responding to acquire this stimulus at the rate of 96 responses per minute. During segment three, a control segment, Subject 1 responded in bursts followed by periods of no response, although regardless of his behavior he received the same stimulus, W. Throughout segments four and five Subject 1 was consistent in his choice of W over G, since he responded during segment four and did not respond during segment five. Segment six, in which the subject could not obtain the favored W, was programed until Subject 1 ceased responding for at least 30 seconds. In segment seven, when the favored stimulus was reinstated, Subject 1 quickly discerned the contingency shift and responded at an average response rate of 143.4 to acquire W. During the final segment Subject 1 responded momentarily and obtained G, but then ceased responding and was granted W.

The lower portion of the figure depicts Subject 1's preference for T over P. During segments one, four, and seven he chose not to respond and received T. This subject's T preference was further confirmed, since he responded at quite high rates during segments two, five, and eight to obtain that stimulus.

The first episode of Fig. 2 illustrates Subject 2's preference for T over W. This subject responded at or beyond the response requirements of 120 to obtain T during segments one and four, and acquired the same stimulus during segment two by not responding.

The arrangement of segments three, four, and five for Subject 2 appears to be an expedient contingency sequence for obtaining convincing preference data. Maximal data is provided in a short period of time by programing: (a) the nonpreferred control; (b) a segment with the preferred stimulus contingent upon responding; and finally, (c) a preferred control condition. During the nonpreferred segment (three), Subject 2 was run until he extinguished for 30 seconds. Then, without a cue to him, the contingency was arranged (segment four) so that the preferred stimulus might be obtained if he responded. The time period from the beginning of segment four until he responded was quite short. After Subject 2 established a stable and high rate during segment four, a control situation (segment five) was arranged. Following the initiation of the new contingency, the subject responded 88 times before he ceased and obtained the stimulus without effort.

The bottom portion of Fig. 2 represents Subject 2's preference for P over G. During segment one he received P by not responding; and during

segment two, when the contingencies were reversed, he responded at a high rate to receive P. Based on his performance during these two initial segments, the aforementioned sequencing of subsequent experimental segments was programed. Segment three represents the nonfavored control segment; segment four, the favored stimulus contingent upon responding; and the final situation, segment five, the favored control segment. Subject 2's response pattern throughout these segments was almost an exact replication of his behavior during the final three segments of the first session.

Because limited verbal interaction is required and quantifiable data are readily obtained when conjugate schedules are used to assess preference, this contingency could perhaps be used to explore further dimensions of communication and aesthetics. For example, the relative reinforcing effects of such verbal parameters as enunciation, timbre, and rhythm could be experimentally assessed by this method. Subtle preference differences between symphony orchestras, string quartets, and soloists may also be subject to analysis by conjugate reinforcement.

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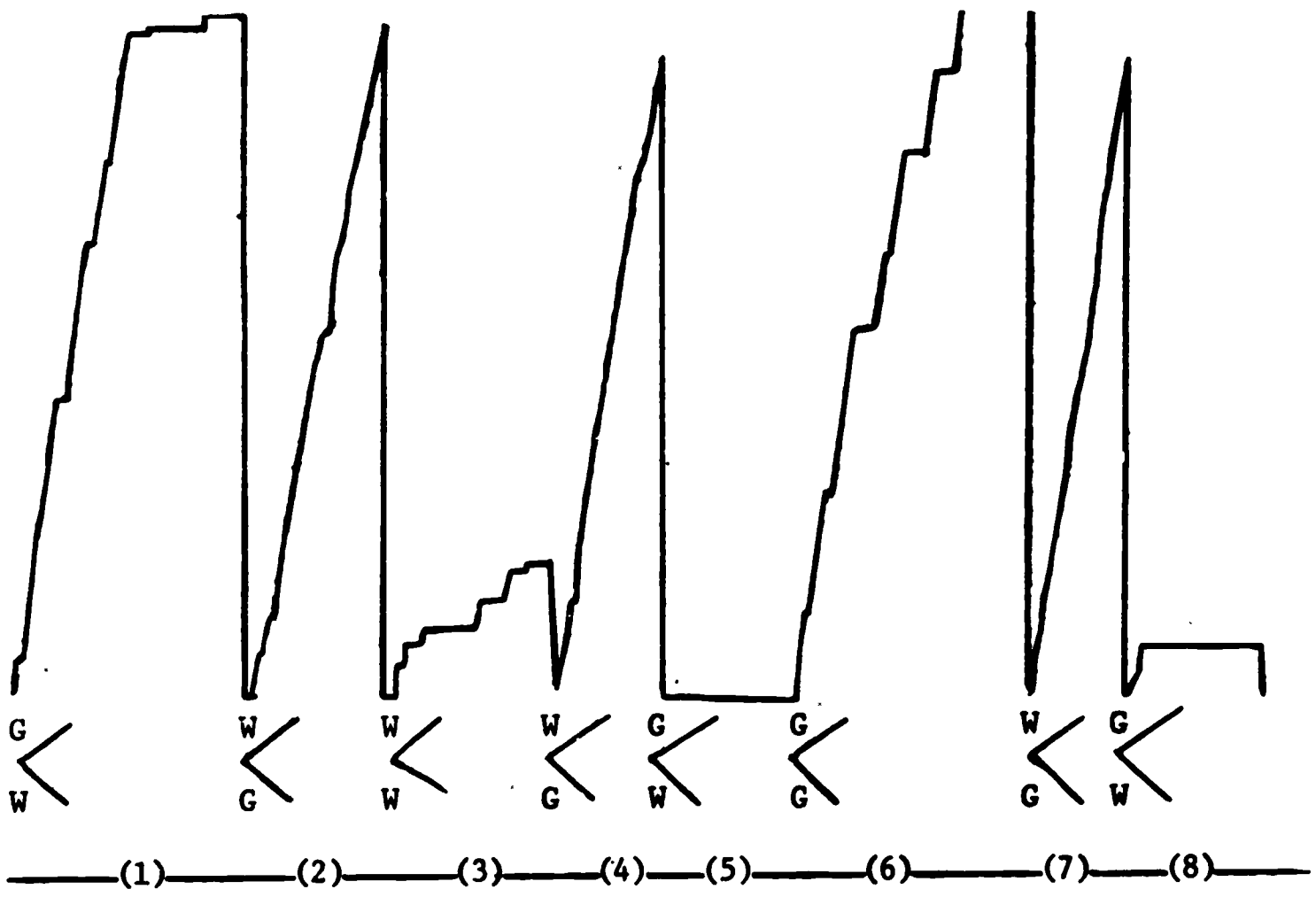
Fig. 1. Cumulative records indicating S1's preference for W over G and T over P.


G
W
W
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W
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G
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G
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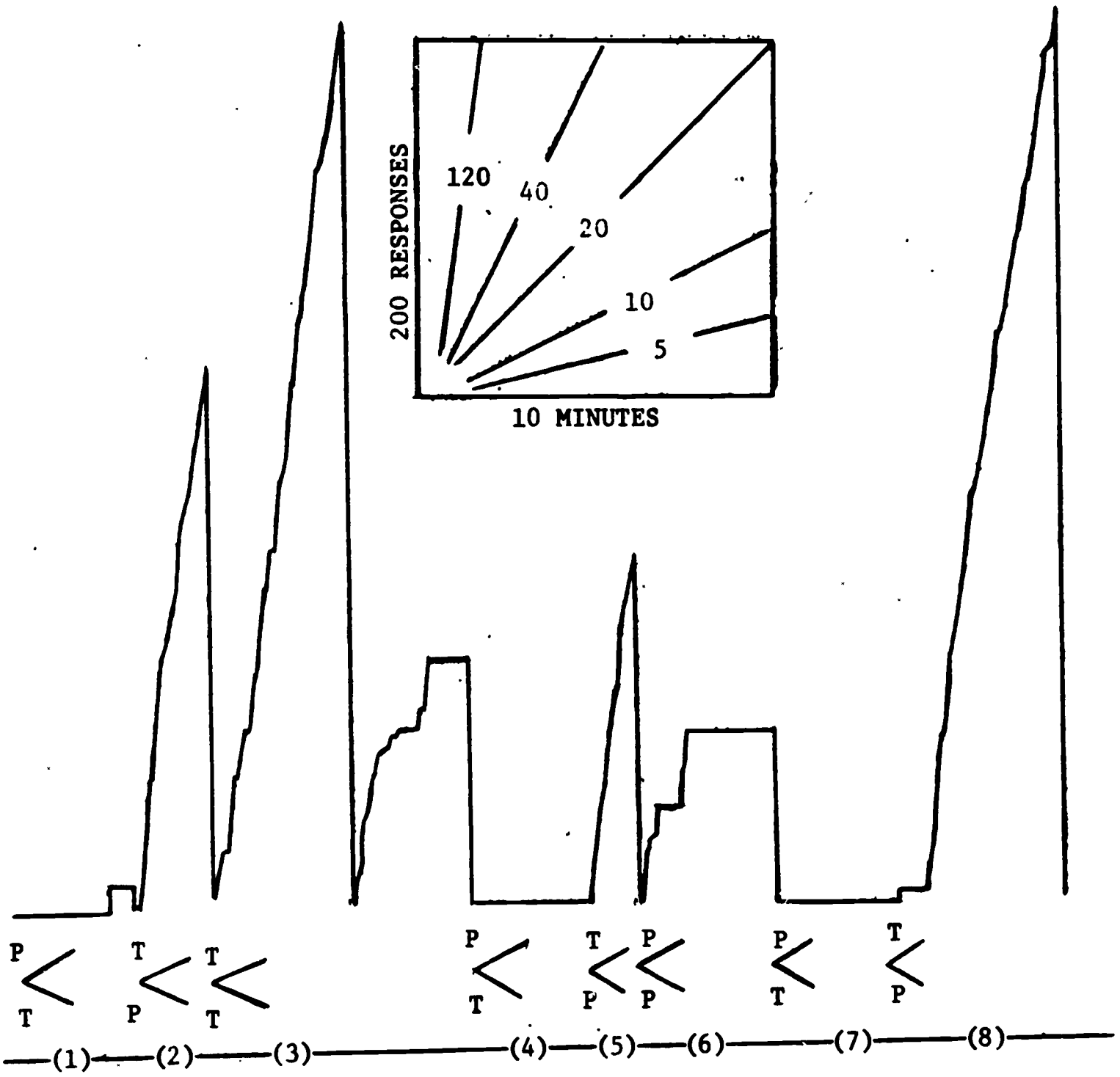
G
W
G
(1)
(2)
(3)
(4)
(5)
(6)
(7)
(8)


200 RESPONSES
120
40
20
10
5
10 MINUTES
P
T
T
T
P
T
P
T
T
P
P
T
P
P
T
P
T
(1)
(2)
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(4)
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(6)
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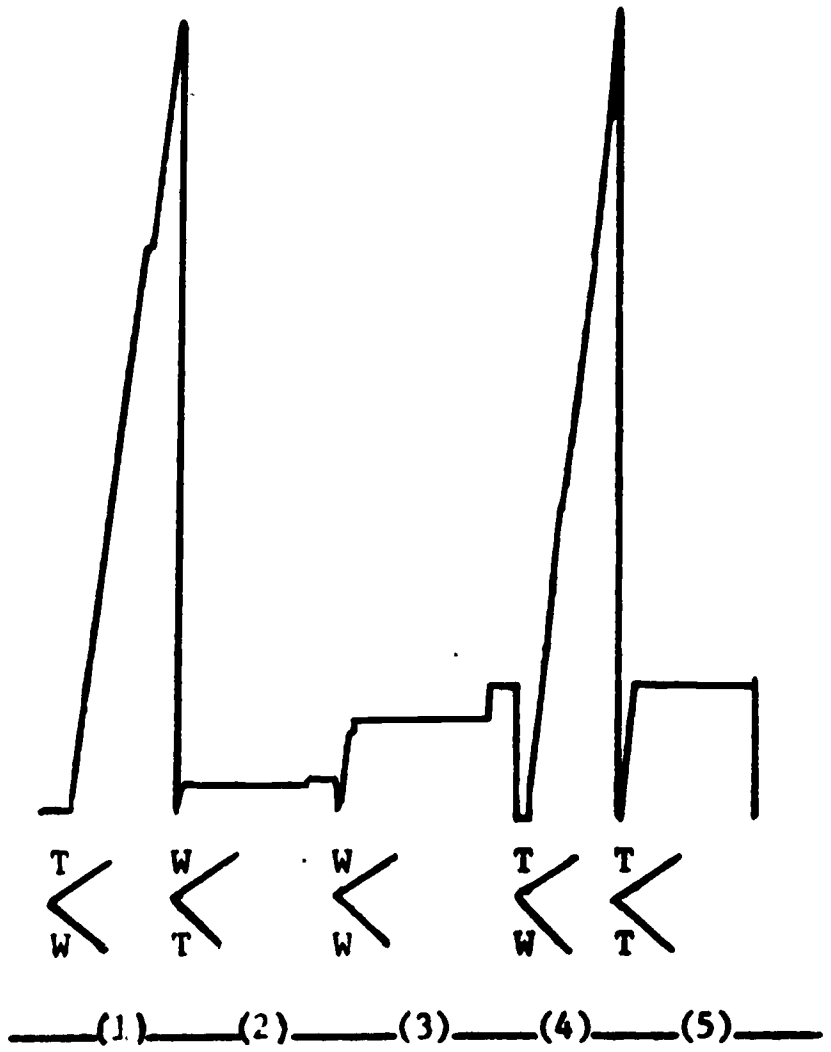
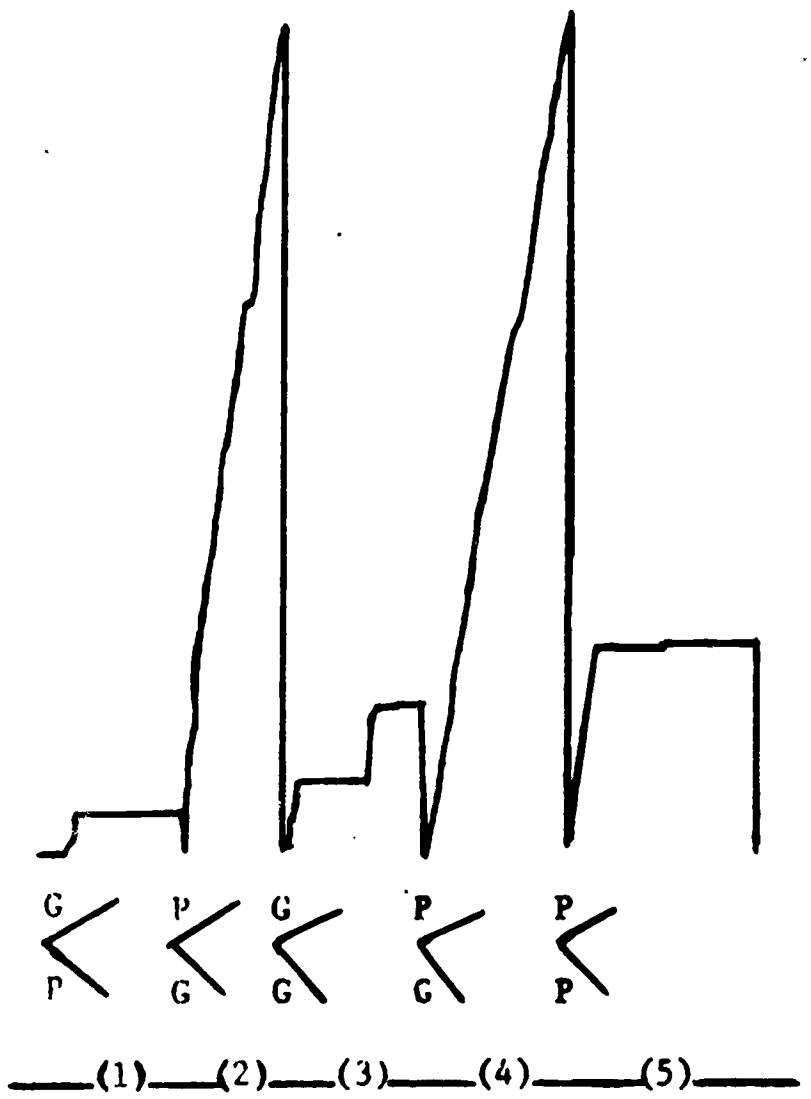
Fig. 2. Cumulative records indicating S2's preference for T over W and P over G.


T W W T T
W T W W T
(1) (2) (3) (4) (5)


G P G P P
P G G G P
(1) (2) (3) (4) (5)

READER PREFERENCE: A FREE-OPERANT ASSESSMENT

The reinforcing effects of such narrative stimuli as stories, music, television, and movies have been difficult to evaluate (Lindsley, 1962). Unlike tangible reinforcers such as tokens or M & M's that may be provided episodically, contingent upon responding, narrations such as stories are not suitable as reinforcers when presented only for brief durations and at periodic intervals; for the thread of continuity--one word or phrase leading to another--is usually lost if the narration occurs intermittently. Short bursts of words or passages of music could, in fact, serve to tantalize rather than reinforce. Indeed, it would be an unusual subject who would not be "frustrated" by hearing occasional fragments of John Phillip Sousa or Herman Melville contingent upon his responding.

Narration, to be properly evaluated, must be programed by a continuous schedule of reinforcement (Bijou and Baer, 1967). That is, contingencies must be arranged so that the subject may obtain the narrative at all times. Conjugate contingencies have, to a large extent, met this requirement of continuity; for in such schedules the intensity of the narration is a direct, immediate, and continuous function of the subject's responding.

A single narrative may be conjugately programed so that its availability is contingent upon either responding or not responding. When a stimulus is contingent upon responding, the subject can receive it by responding at or beyond a preset rate. Lesser responding attenuates the stimulus; and when the subject ceases responding altogether, he can no longer obtain the stimulus. If a stimulus is contingent upon not responding, the subject is granted the stimulus only if he does not respond; the greater the responding, the less the intensity of the stimulus.

When two narrative stimuli are simultaneously and continuously available, the subject may receive one by responding and the other by not responding. If he desires, for example, to listen to story A, programed as a response-contingent story, he must respond continuously at or beyond a preset rate. If his rate of response gradually falls below the prescribed rate, he is simultaneously provided with the preferred stimulus A at a lesser intensity and the alternate stimulus B at an increased intensity. Moreover, if the subject ceases responding altogether, he receives none of the preferred A and maximum intensity of the non-preferred B narration. As with the programing of a single stimulus, the opposite of this contingency could also be scheduled, so that A was available to the subject through not responding and B through responding.

The conjugate technique, used to assess behavior as a function of a variety of variables, was recently used to assess the reinforcing effects of various literary forms (Lovitt, 1967a). During this investigation, five types of narration were sequentially offered to a group of boys. Response rates were continuously recorded as these subjects responded to obtain a juvenile story, a journal article, a poem, a story read backward sentence by sentence, and a story read backward word by word. The results revealed that when preference was defined in terms of magnitude and variability of response, some narrative forms generally maintained higher and more stable preference rates than others. It was apparent, however, that each subject had a rate pattern that was quite unique.

In a subsequent study, Lovitt (1967b) determined the preferences of a group of 12-year-olds for one of two simultaneously presented stories. This study revealed, for six of seven subjects, a definite preference for one story over the other, five preferring an adventure story, one preferring an animal story, and one preferring portions of each story.

Conjugate contingencies were again used by Lovitt (1968) to assess another variable of narration, speed of speech. In this investigation, involving normal and retarded subjects, it was reported that none of the retardates preferred the normal (180) wpm rate, most of them preferring slower rates of speech. The majority of the normal subjects, however, responded in a manner indicative of a preference for a normal (180) wpm speech rate.

Although content and rate of presentation appear to be two of the more obvious dimensions of narration, other components of the narrative process merit experimental analysis. Therefore, the intent of the current study was to isolate a third variable of narration--type of reader, male or female--and conduct an analysis of subject preference.

The independent variable, type of reader, is not a precise dimension and cannot be assessed parametrically, as can speed of speech. Rather, it is composed of a number of speech characteristics. It was believed, however, that this preliminary focus on the broad topography of speech should be undertaken prior to a more intensive analysis of other component variables.

Method

Subjects

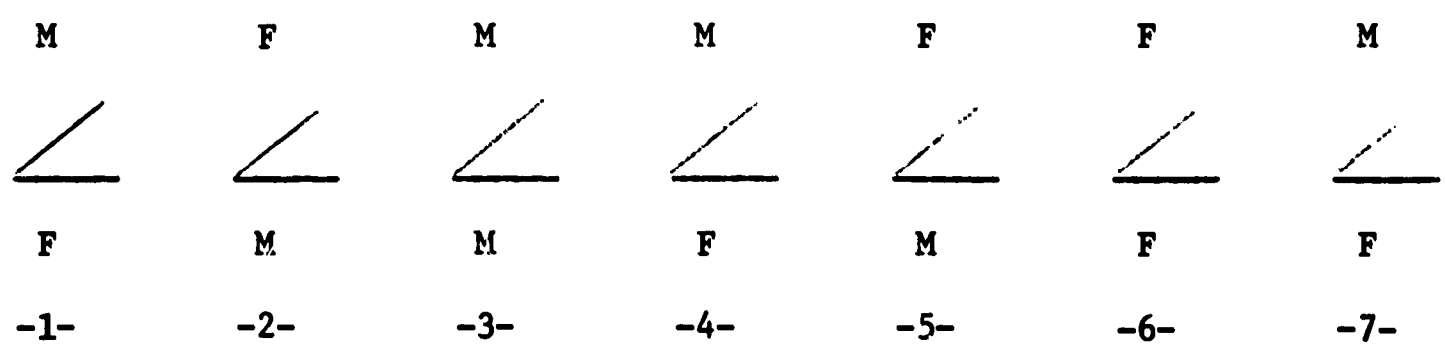
The subjects consisted of five boys (retarded children, RC-1 through RC-5), ages 10-13, who attended the Experimental Education Unit, University of Washington, and one sixth grade boy (normal child, NC-1), age 11, who attended school in Kirkland, Washington.

Procedures

The subjects were placed in an experimental room and told that they would be listening to stories. Two tape recorders, each with a version

of the story White Falcon, were operated by the experimenter. Although identical in fidelity, intensity, and word-per-minute rate (about 180 wpm), one tape was read by a male reader and the other by a female. Both tapes were run constantly (except during certain control segments) throughout the session in order that the subject could freely switch from male to female reader or vice versa. The factor of familiarity of the reader voices was accounted for, as neither of the voices was familiar to the subjects in this study.

Each experimental session consisted of seven segments which lasted, depending upon the rapidity with which the subject discerned the various contingency shifts, from 20 to 40 minutes each. The following diagram indicates the arrangements of the experimental segments presented to the majority of the subjects.



The "F" in the above diagram denotes female and "M" male. F or M on the top of the symbol indicates increase conditions, whereby the subject must respond at a preset rate to acquire that stimulus. When the letter is on the bottom, decrease conditions are indicated, in which the subject receives the stimulus by not responding. If the subject responds, but at a rate below the preset requirements, he simultaneously receives portions from both tapes at moderate intensities.

The first two segments of the above diagram were alike for all subjects, with the programing of the remaining five segments dependent upon subject responding during this phase. If the subject's responding during these two segments indicated an initial preference for the male voice (responding during segment one and no responding during segment two), the five remaining segments were arranged like those in the above diagram. If after the first two segments, however, the subject indicated a female preference (no responding during one and responding during segment two), an alternate arrangement of contingencies was programed.

In all instances the third segment was a preferred control segment, in which the subject obtained his preferred stimulus regardless of responding. Segments four and five, for those who indicated a male preference, were the same as segment one and two--male increase during segment four and female increase during segment five. Opposite programing was arranged for those initially preferring the female reader--female increase during segment four and male increase during segment five. During segment six the non-preferred control was scheduled, in which the subject could obtain only the non-preferred stimulus regardless of responding. The final segment was composed of the preferred stimulus as an increase option and the non-preferred as a decrease option.

Segments one, two, four, five, and seven were in effect until the subject stabilized responding by either continuously responding or not responding for at least two minutes. Segments three and six, the control components, were in effect until the subject ceased responding for at least one minute.

The arrangement of the experimental segments for each subject was sequenced in such a way as to obtain as conclusive evidence of preference as possible. First, two additional replications (segments four and seven) of the subject's preference in segment one were programed.

Secondly, the experimental segments were arranged so that a temporal discrimination of contingencies would not be probable. If, for instance, the segments were arranged so that the subject could continuously receive his favored stimulus by alternately responding and then not responding, it could be argued that his "preference" was more the function of a temporal than an auditory discrimination. Typically, a subject who preferred the male reader would respond during segment one, not respond during segments two and three, respond during four, not respond in five or six, and again respond during segment seven. Thus, two temporal breaks were programed for a subject preferring the male reader. Similar temporal irregularities were scheduled for subjects preferring the female reader.

Finally, a narrative interruption was scheduled for each subject. It could be reasoned that if both stimuli were constantly available, the subject's initial stimulus commitment might influence his subsequent selections throughout the experiment. In other words, should the subject obtain the male reader during the first segment, he might continue selecting this stimulus rather than interrupt the narration to sample the alternate stimulus. Therefore, if the subject had not adequately sampled both narrations, it could be concluded that a mere discrimination had been made, not a choice. To overcome this possibility, a narrative interruption was scheduled in segment six so that, regardless of his responding, the subject could no longer obtain his favored narration. Following this interruption of the preferred narrative, the subject could either reaffirm his initial preference or, by continuing to not respond, receive the previously non-preferred stimulus.

The response requirements for the subjects were experimentally determined by allowing each subject to respond freely with the microswitch before the programing of any narrative stimulus. For RC-1, 2, and 4 and for NC-1, this prenarration response rate was 120 responses per minute. For RC-3 the base rate was 80, and for RC-5, 40.

Results

When preference is defined as differential rate of response for one stimulus over another, the results of this study revealed that only RC-2 and NC-1 did not prefer the male reader. RC-2's response pattern indicated a preference for the female reader, while NC-1's response pattern did not indicate a preference for either reader.

Figure 1 is the cumulative record of RC-1's operant preference for the male reader. When the male option was provided on increase conditions (segments one, four, and seven), the subject's response rate followed closely the preset response requirement of 120 per minute. Conversely, when the male reader was offered as a decrease option (segments two and five), the subject did not respond and accepted the decrease stimulus. During segment three, the male control conditions, RC-1 continued to behave in a manner indicative of a male reader preference by continuing to not respond--making no attempt to obtain another stimulus. During segment six, the female reader control condition, he could not obtain the male reader option and accordingly responded in a searching, probing manner. These response bursts could indicate either that he was trying to avoid the female reader or that he was trying to obtain the male reader. Although both options were available during the final segment, it appeared that since during the preceding segment RC-1 had received the female reader regardless of his behavior, he was unaware that a choice was now possible. Thus, he continued to listen to the female reader for 36 seconds during the final segment before responding and obtaining the male reader option. From that point, he steadily responded at a high rate to acquire the male reader.

Figure 2 depicts RC-2's preference for the female reader, initially indicated by his performance during segments one and two. As illustrated in Figure 2, the subject (except for one response burst) did not respond during segment one, thus being granted the female reader. During segment two, however, when the contingencies were reversed, the subject's response pattern also reversed. Segments four and seven represent a replication of RC-2's behavior during segment two, while segment five indicates a replication of his absence of responding during segment one.

During segment three, the preferred control, any form of responding was non-functional, since only the preferred stimulus was available, regardless of responding. As noted in the figure, the subject continued responding at about the same rate as in the preceding segment for approximately 225 responses, then declined until he ceased responding for about 30 seconds, emitted 200 more responses, and finally ceased responding for 1 minute 24 seconds.

During segment six, the non-preferred control component, RC-2's response pattern was quite different from his responding during the preferred control segment. The subject made 232 responses in 2 minutes before cessation of responding. Seven such plateaus of no responding for periods of 20 seconds or longer were recorded before the subject finally ceased responding altogether for 2 minutes 36 seconds. Because of the periodic bursts of responding followed by periods of no responding, RC-2's behavior during the non-preferred control segment was more reminiscent of behavior during periods of experimental extinction than was his behavior during the preferred control segment three.

Discussion

Data indicative of individual preferences for any of the dimensions of narrative stimuli could be utilized in several ways. First, because of the long-lasting reinforcement effects of narration (Lovitt, 1968), narrative preferences could be used as consequences, whereby the subject is required to emit a certain response rate to obtain the favored narrative form. Unlike many other reinforcers, which because of satiation effects must be replaced by secondary or conditioned reinforcers to maintain behavior, contingent stories are capable of maintaining behavior for very long periods of time.

Second, this information could be used by the programer to select the most efficient stimulus mode. If some children are most reinforced by male readers who speak at normal rate, they could be presented auditory material using such a type of reader and rate of speech. Other prosthetic settings could be arranged for those who are reinforced by speech of specific speeds, timbres, and intensities.

Thirdly, the narrative preference of some subjects could be so deviant that the management decision is to alter the preference. Certain individuals, for example, could be reinforced by extremely rapid or loud speech, or narration that is syntactically garbled. Perhaps speech at normal rates, at moderate intensities, and of conventional syntax patterns is no more meaningful for these persons than background murmurs. Indeed, many of the "special education behaviors" such as poor attention span, distractibility, and hyperactivity could be the result of some subjects' failure to respond in an organized fashion to the instructions they receive. Many of these messages may not be attended to because few of the components or dimensions of speech have attained a discriminative function for these people.

Future investigations, however, need to isolate other narrative variables. Certainly maleness-femaleness is a rather all inclusive category for studying the characteristics of speech. The results of this investigation then, cannot be interpreted to mean that for the majority of these boys male voices are more reinforcing than female voices, much less that males generally are more reinforcing than females. For speech characteristics are the composite of a number of dimensions such as rhythm, rate, intensity, and timbre. Future assessments could be made, therefore, of the reinforcing effects of a high and low pitched voice or of loud versus soft speech. Further investigations could be designed to assess subject preference for steady versus variable speech as well as individual options for certain rates of speech.

Although preferences for some types of narration have been assessed (Lovitt, 1967), future investigations also need to isolate other thematic or content variables of narration. Preferences could be determined for types of poetry, such as narratives, lyrics, or ballads. Likewise, assessments could be made of such prose forms as biography, essay, historical novels, romances, and science fiction.

In addition to the assessment of certain speech characteristics and a variety of content variables, analyses could be performed of specific syntactical arrangements. Narration could be assessed not only in terms of sentence or phrase length, but also by the structural arrangement and sequencing of grammatical elements.

With the current concern for language assessment and development and for the process of communication in general, all identifiable dimensions of the language process must be considered--speech characteristics as well as content and syntax.

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Fig. 1. Cumulative record indicating RC-1's preference for the male reader.

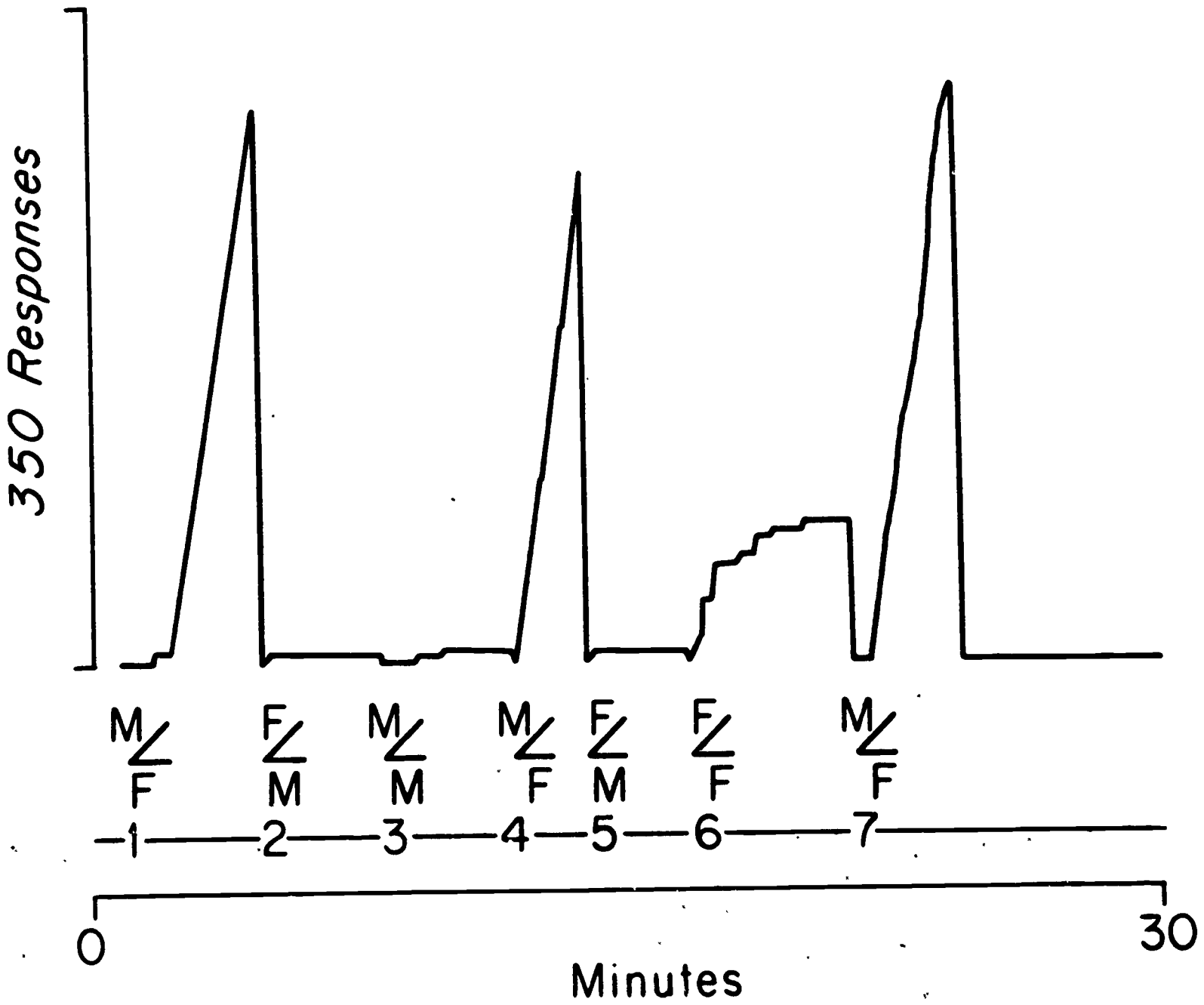
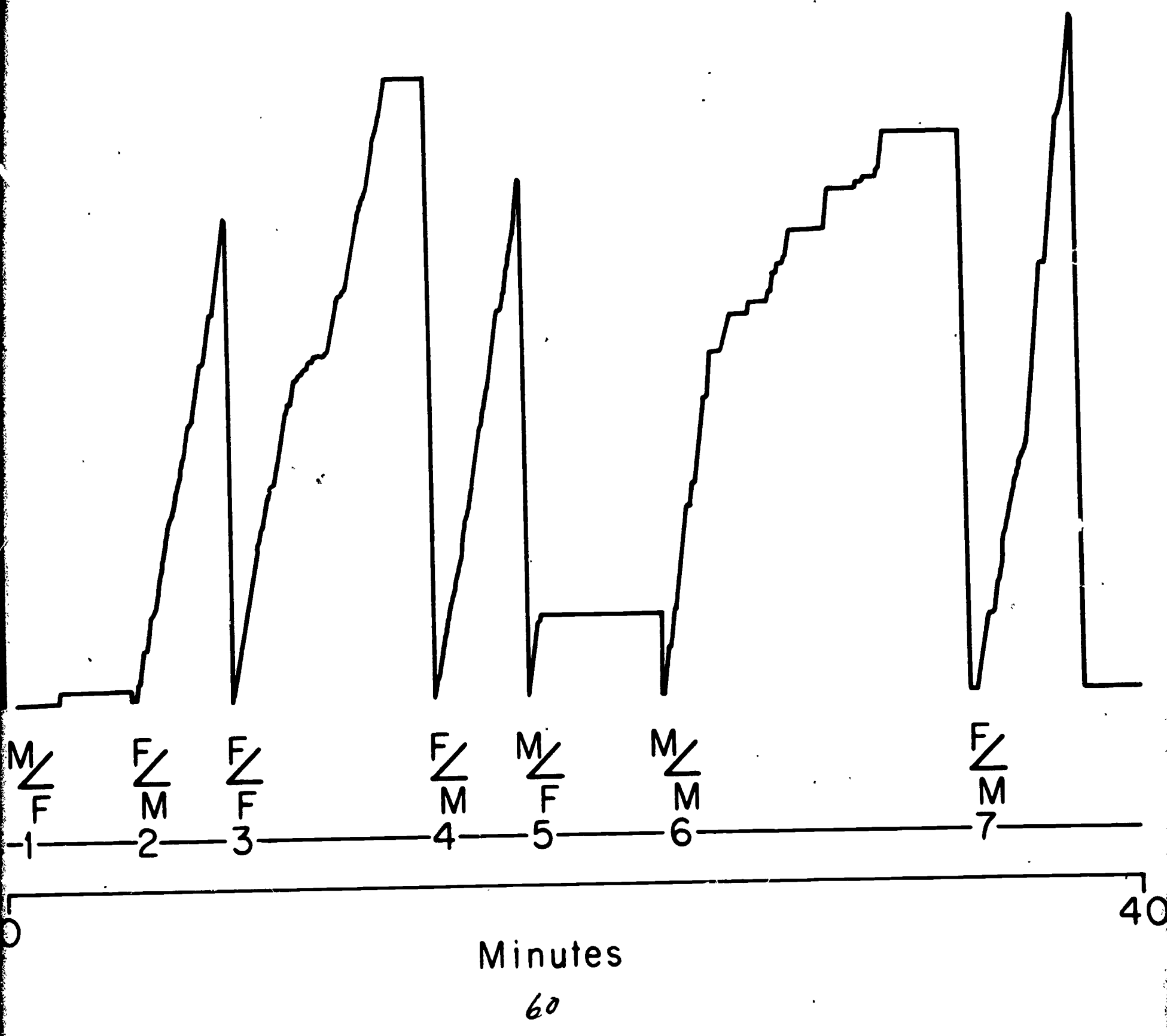

350 Responses
M/F
F/M
M/M
M/F
F/M
F/F
M/F
1
2
3
4
5
6
7
0
30
Minutes

Fig. 2. Cumulative record indicating RC-2's preference for the female reader.


M/F
F/M
F/F
F/M
M/F
M/M
F/M
1
2
3
4
5
6
7
0
40
Minutes

RELATIONSHIP OF SEQUENTIAL AND SIMULTANEOUS PREFERENCE AS ASSESSED BY CONJUGATE REINFORCEMENT

Efforts to assess the reinforcement preference of humans have met with limited success. In a laboratory situation the inability to evaluate the relative effects of reinforcing stimuli may in part be due to the experimenter's inability to bring the subject's response under the control of an appropriate stimulus (Bijou, 1958). In a free environmental situation this same lack of control may be attributed to discrepancies between a subject's verbalized and his operant preference (Morgan and Lindsley, 1966; Lovitt, 1968).

These problems of quantifying the relative effects of reinforcers have been alleviated to a great extent by the use of conjugate reinforcement. Conjugate contingencies, unlike episodic schedules, supply the subject with an immediate and moment-to-moment feedback as to his response efforts, as the subject's rate of response directly controls the intensity of the reinforcing stimulus. Conjugate contingencies are particularly suitable for the analysis of complex narrative themes, both visual and auditory, that cannot be offered in an episodic manner without considerable loss of reinforcing value.

The conjugate tactic has been used by Lindsley (1962) to assess the relative reinforcing effects of sequentially programed television offerings and by Lovitt (1967a) to determine the reinforcing effects of five sequentially programed narrations. In both of these investigations the reinforcing effects were determined by a subject's rate and variability of response. High and stable response rates to one stimulus indicated sustained reinforcing effects, while a lower and more variable rate of response indicated lesser reinforcing effects. In the cited investigations the more deviant a subject's rate of response from the preset response requirement, the more the intensity of the programed stimulus faded. If a subject failed to respond completely, he received only silence.

Conjugate reinforcement has also been a reliable schedule to assess the relative effects of two simultaneously programed stimuli. Morgan and Lindsley (1966) reported that by simultaneously offering monophonic and stereophonic music they were able to obtain continuous records of the comparative reinforcing effects of either dimension of music. Lovitt (1968, 1967b) demonstrated that conjugate contingencies were sensitive to such subtle narrative variables as speech rate and type of story when either two speaking rates or two stories were offered simultaneously.

It was the purpose of this investigation to compare the relationship of sequentially and simultaneously programed stimuli with concern centered on a determination of individual preferences. The question asked was: If a subject responded at one rate for a stimulus and a higher rate for another stimulus when the stimuli were sequentially

programed, would he demonstrate a concomitant preference when the same stimuli were simultaneously programed? A further concern was to compare subject response rates during sequential and simultaneous conditions. For example, would a subject respond at a higher or lower rate when two stimuli were simultaneously available than when only one stimulus was offered?

Method

Subjects

Subjects were eight boys ranging in age from 10 to 14 who attended regular public school classes in Northeast Johnson County, Kansas and 14 boys of the same age who attended special education classes in either Johnson County, Kansas or Seattle, Washington.

Apparatus

Two Wollensak tape recorders, model T-1500, were associated with the conjugate-servo mechanism to provide the stimuli. The programing equipment consisted of traditional relay circuitry, a pulse former, and an E1100H timer. Subject responding was recorded via a Gerbrands cumulative recorder that indicated both rate of responding and stimulus intensity at any given moment.

Procedure

Subjects sat in a partially sound attenuated room and were provided with a handswitch and headphones. They were told they would be listening to music and stories and that they could press the switch if they desired. Each subject participated in two 20-40 minute experimental sessions. The subject was first offered music on increase conditions, then on decrease. During increase conditions the subject had to respond at a preset rate to obtain the offering at full intensity, while during decrease procedures responding attenuated the stimulus. A similar arrangement, alternating increase and decrease conditions, was arranged for the story. The data from the decrease conditions were not incorporated in the final analysis of a subject's sequential preformance since response rates during these conditions were always near zero. However, it was a necessary control session that indicated whether a subject was more reinforced by button pushing than by silence.

During the subsequent experimental segments, the music and story were simultaneously offered. The first segment of simultaneous programing involved the offering of music on increase conditions and the story on decrease. The contingencies were reversed on the next segment; music on decrease and story on increase. If a subject desired to listen to the stimulus on increase conditions he had to respond; if he chose to listen to the decrease option, he had to stop responding. Furthermore, if he responded at median rates he heard portions of both narrations. The response rates required to maintain the stimulus at maximum intensity were functionally determined for the subjects by allowing

them, before the introduction of any stimulus, to respond freely with the microswitch.

Results

Table 1 presents the response rates of all subjects for the four experimental conditions. NC has been used as a symbol for normal child and RC to denote a retarded child. Music on increase is represented by $^{M}\!<$; $^{S}\!<$ is story on increase; $^{M}_{S}\!<$ is music increase and story decrease; $^{S}_{M}\!<$ is story increase and music decrease.

Relevant to the first point of concern in this study, the operant agreement of sequential and simultaneous preference, it may be observed that of the retardates, six responded in a similar fashion and eight responded in a discrepant manner. Of the normals, the sequential and simultaneous preference was synonymous for six subjects and discrepant for two. These findings, when subjected to a Fisher probability analysis, proved to be insignificant.

With reference to the second concern of this study, the magnitude of difference between sequential and simultaneous responding, it was noted that 4 of the 14 retardates responded more during one simultaneous segment than during either of the two sequential segments while 7 of the 8 normal boys responded at higher rates when two stimuli were programed than when one stimulus was offered. These data, when analyzed by the Fisher probability test, were significant beyond the 0.05 level of confidence.

Discussion

From the data of this investigation it appears that if a boy indicates a greater preference for A than for B in a sequential offering, normal behavior shows a duplication of the preference of A when A and B are simultaneously offered. Perhaps agreement between sequential and simultaneous preference is one of the many social and verbal variables that indicate either retarded or normal behavior. This congruity of sequential and simultaneous preference could be one of the indicators of normal behavior as is the ability to match operant and verbal preferences. A previous investigation (Lovitt, 1968) reported that operant preference (an on-going, continuous assessment) and verbal preference (an after-the-fact, single assessment) were significantly more synonymous for normal than for retarded boys.

As to the difference in magnitude of response rate between sequential and simultaneous sessions, normal behavior would be indicated by an increased rate of response for the preferred stimulus when two stimuli were programed simultaneously. It is not surprising that response rate during simultaneous conditions should surpass response rate during sequential conditions because, during simultaneous

contingencies, the nonpreferred stimulus gradually appears when responding for the preferred stimulus diminishes. Correspondingly, as a subject's response rate attenuates during sequential contingencies the stimulus is replaced by silence rather than another stimulus. Thus, during simultaneous contingencies, if the subject responds at rates lower than the requirement not only does the preferred stimulus fade, but the nonpreferred gains prominence.

This observation of response rate increase for a preferred stimulus as a function of simultaneously offering a lesser preferred stimulus, has been demonstrated in a classroom situation (Lovitt and Curtiss, 1967). A portion of a boy's school day involved the simultaneous offering of two academic programs--reading and math. He was free to select either of the programs during this time. Throughout other times of the day the boy was offered reading and math without a choice. He worked on math only, for a period of time, and then on reading. The data from this investigation revealed that this subject's rate of response was consistently higher for reading than for math when each was sequentially programed. Furthermore, the data indicated that the subject's rate of response for reading during the simultaneous period, when the lesser preferred math was available, was significantly higher than his rate for reading during the regular sequence of daily activities. If these findings continue to prove reliable, i.e. response rates for a preferred stimulus will increase as a function of simultaneously offering a lesser preferred stimulus in a free choice situation, there are apparent immediate educational and psychological implications of considerable importance.

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Table 1. Individual Response Rates of Four Experimental Schedules

Component	M <	S <	M < S	S < M
NC 1	48	46	4.8	46.8
NC 2*†	42.6	42	54.6	0
NC 3†	80	68	5	100
NC 4*†	80	106.8	0.4	132
NC 5*†	21	56.4	0	60
NC 6*†	34.2	35.4	0	36.6
NC 7*†	106	146	9.3	150
NC 8*†	38	40	0	62.4
RC 1*	37.8	80	0	77.3
RC 2	53.4	19.2	5.6	45
RC 3*†	41.4	61.2	0	66
RC 4*	20.4	19.8	17.4	0
RC 5†	55.8	58.2	74.4	0
RC 6	53.3	99	72	36
RC 7	60	21	0	30
RC 8	52	24	16.2	30
RC 9*	134	160.2	0	93.3
RC 10*†	102	67.8	104	0
RC 11	19.8	16.8	1	13.8
RC 12*†	92	136.8	3	190
RC 13	120	77.4	15.6	87
RC 14	60	21.6	0	24

*Agreement between simultaneous and sequential preference.

†Response during one simultaneous condition greater than during either sequential condition.