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ABSTRACT

As a result of findings of a previous study, this study, which sought to program preschool subjects to wait one minute for reinforcement, used pause-building procedures before delay conditions were started. The children, 3- to 5-year-olds, were designated either Baseline (control) subjects (n=3) or Programmed (experimental) subjects (n=5). Though procedures varied in detail for each subject, the general plan followed was for the Baseline subjects to be put right into 60 second delay periods (after initial pause-building training) and for the Programmed subjects to receive a program of training steps in addition to the pause-building training before facing the 60 second delay of reinforcement. These training steps involved multiple schedules of continuous reinforcement and progressive differential reinforcement, discriminative stimuli that were gradually faded out, and increasing delay of reinforcement. The pause-building training, apparently a prerequisite for successful entry into the training program, was effective, and so was the programmed training for the experimental group, but only up to the point where discriminative stimuli for not responding were faded out. (MH)

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Kansas Progress Report, August 1968

A PROGRAM OF STIMULUS CONTROL FOR ESTABLISHING A ONE-MINUTE WAIT FOR REINFORCEMENT IN PRESCHOOL CHILDREN[1]

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A previous study, Errorless Discrimination in Preschool Children: A Program for Establishing a One-Minute Delay of Reinforcement (Kolb, Etzel, 1967), indicated that some pause behavior was essential before it was appropriate to put the program of learning to wait 60" for reinforcement into effect. Of the nine Programmed Subjects placed under delay conditions in the first study, only three emitted the behavior of not responding during brief periods of delay, with the corresponding stimuli of darkened response button and no tone. That is, six continued to respond during brief periods of delay as they did during the VI component of the study.

Therefore, pause-building procedures were introduced in this study before delay conditions were started. A three-step preliminary training procedure (for pause-building) was presented to all Subjects, Baseline and Programmed. The first step established a lighted response button as the discriminative stimulus for responding, and a dark response button as the discriminative stimulus for not responding. The dark button condition was introduced after the first reinforced response to the lighted button, and remained dark for 1". Each additional single response to the lighted button was reinforced, and terminated the lighted response button condition for intervals that increased in length by 1" (if the subject did not respond during the dark button condition). If responses did occur, the button remained dark until no responding had occurred for the number of seconds programmed for that interval. Step 1 increased the dark button condition to 10".

Step 2 introduced two additional stimuli potentially discriminative for not responding: flashing red lights and a repeated tone during the dark button interval. Responses during the dark button condition postponed the lighted button condition. There were five 10" intervals of dark button condition in this step.

VI 5-sec training was given during Step 3 when the Subject was switched from CRF to VI 5-sec. The dark button condition between the VI components was held at 10" if no responding occurred; but was extended in length to meet 10" of consecutive no responding if responding did occur.

METHOD

Subjects

The Ss were 3- to 5-year-old preschool children attending the Edna A. Hill Child Development Preschool Laboratories at the University of Kansas. The study was conducted in an experimental booth located in the Preschool. One Programmed Subject was eliminated from the study, failing the requirement of not responding during DRO in Step 1 of the training procedure.

Apparatus

A Grason-Stadler push button was mounted on an adjustable panel inserted into the wall of an experimental booth, positioned approximately four inches below the eye level of a seated child. An inline digital readout unit illuminated the push button, projecting a figure "0" into the center of the push button. Brightness of the display was controlled by a rheostat calibrated in thirty equal dimming steps to reduce the light from full brightness to off.

A Gerbrands poker chip dispenser mounted behind the panel delivered poker chips into an enclosed plastic container located beneath the push button manipulandium. A hand-switch with lead wires long enough to reach from the rack was available for the Experimenter's use inside the booth.

Control equipment was mounted on a relay rack outside the experimental booth. An interval programmer and interval timer were used to program the variable interval schedule. An alternator was used to turn off the response light and deliver a single tone at the completion of the VI response requirements. The alternator also controlled the delivery of a series of tones and flashing red lights during the delay period. The series of tones was controlled by a potentiometer calibrated in thirty equal steps to reduce the volume from full to inaudible. Both the single tone and the series of tones were delivered to the subject through earphones placed over a toy plastic army helmet with openings cut in the helmet underneath the earphones. The tones also came through a speaker mounted above the response panel. Both earphones and wall speaker were used in the event that if a S removed the helmet momentarily, he would still be presented the auditory stimulus.

Red lights were installed in an 8-inch diameter circle around the response button. They were covered with a sheet of translucent plastic cut the size of the adjustable panel, with the response button flush with the surface of the plastic. These lights flashed on and off in synchronization with the tone during the delay period. The intensity of the lights was controlled by a variable resistor calibrated in thirty equal steps from full brightness to off.

White noise was delivered through two additional speakers mounted above the subject on opposite sides of the booth. This was used to mask sounds produced by the experimental equipment.

A Gerbrands Harvard cumulative recorder was used to record all responses and mark reinforcements. An event pen recorded the duration of the schedule intervals and the delay periods. Responses during VI, the first two seconds of delay, and the entire delay period were recorded on separate digital counters.

Procedure

Three Baseline Subjects, $\underline{S}_1$, $\underline{S}_2$, and $\underline{S}_3$, and five Programmed Subjects, $\underline{S}_A$ through $\underline{S}_E$ served in this experiment. Each subject was brought from the schoolroom to the experimental booth by the Experimenter. The response button was lighted when the subject entered the booth, and white noise was already present. The subject was told to sit in the chair, and the helmet with the earphones attached was placed on his head. The Experimenter pushed the response button and said, "When you push this button you get a poker chip." The poker chip fell into the container and the response button became dark. The Experimenter waited for approximately 1", used her hand switch to illuminate the response button light again, pushed the response button and said, "When you push it again, you get another poker chip." She held a box containing five toys for the subject to see, and said, "When you get enough poker chips you can trade for one of these toys. Which one would you like to work for today?" When the subject indicated a choice, she said "I'll let you know when you have enough poker chips", and left the booth.

A second Experimenter ($\underline{E}_2$) now stepped into the booth and stood behind the subject. During the three step training procedure $\underline{E}_2$ controlled the re-lighting of the response button, after each response, with a hand switch. Each Baseline Subject and four of the five Programmed Subjects received this training before the introduction of delay in Session 1.

The first step of the training procedure was a two-component multiple schedule; continuous reinforcement-progressive differential reinforcement of other responses, i.e., (CRF PDRO). In the first component, the subject made a single response to the lighted response button, which produced a poker chip, a ½" tone delivered through the earphones and speaker, a darkened response button, and the second component of the multiple schedule. The second component lasted for 1" if no response occurred. If responding did occur, the response light remained dark until the DRO 1-sec requirement was met. For each successive trial, the length of the DRO component progressed in length by 1" to DRO 10-sec on trial 10. Hence, the first component of any trial, after trial 1 started only after the DRO requirement of the preceding trial was met.

Step 2 of the training sequence consisted of five trials on a multiple CRF DRO 10-sec schedule. During these trials, the flashing lights and repeating tones were simultaneously faded into the second component of the CRF DRO 10-sec schedule in five equal steps. They were at full brightness and volume during the DRO 10-sec component of the last trial of this training sequence.

The next step transferred the subject from a multiple CRF DRO 10-sec to a multiple VI 5-sec DRO 10-sec schedule. The change was made abruptly on the first trial; there were then four further trials during which the subjects stabilized.

Baseline Subjects, after the training sequence, received four, 60" delay periods during Session 1, except $\underline{S}_1$ whose first delay period was

120". Fifty-six additional 60" delay periods were presented, ten each for Sessions 2-6 and six in Session 7. Conditions for all delay periods were identical for the Baseline Subjects. Each subject started the delay period by responding to a lighted response button on a VI 5-sec schedule. When the response-to-be-reinforced was emitted, the response light flashed off, then on, as a single ½-sec tone was delivered through the earphones and the speaker above the response panel. A delay of 60" ensued before the poker chip was fired by the dispenser into the plastic container. Responding during delay was without experimental consequences.

Four of the five Programmed Subjects, after receiving the three training steps, were introduced to delay of reinforcement at either 2" or 10". (The fifth subject (S_C) received a different preliminary training. A description of this procedure is given under Procedure for Subject C.) They were taken to 20", the delay increasing in length by 2" on each successive trial, during Session 1. During Session 2, the delay was increased from 22" to 44" in twelve trials; and during Session 3, from 46" to 60" in eight trials. The stimuli introduced during the DRO component of the multiple VI 5-sec DRO 10-sec schedule were present during the delay periods (i.e., the dark response button, flashing red lights, and repeating tones). The response button light was lighted simultaneously with the delivery of the poker chip at the end of the delay period.

Session 4 consisted of ten, 60" delay periods. The red lights were faded out in ten steps from full brightness to off, for all Programmed Subjects except Subjects A and C. (The Experimenter inadvertently failed to have the lights on during delay for one phase of the program, and did not use them afterwards for these subjects when their absence did not seem to adversely affect results.)

The fading sessions faded the response light back on to full intensity during delay; and simultaneously faded the intermittent tone out of the delay period along two dimensions: duration and loudness. There were various numbers of sessions for different subjects to complete the thirty trials required in the fading sequence. These and other procedural variations will be described for each individual subject.

Subject A was discontinued after three sessions during the previous study, because she never paused in her responding after delay was initiated. She was then used as a subject in this study. Figure 4 shows the three sessions of VI 5-sec training and the first day of programmed delay in the previous study. Two months later Subject A was given the three-step training sequence described above. She began the program at 2" delay. When she continued to respond during delay, she was returned to the VI 5-sec DRO 10-sec step for 14 additional trials. Subject A was returned to the program at 10" delay and taken to 20" in six steps during Session 1. Session 2 advanced the delay from 22" to 44". The red lights were not present at the start of Session 3 and were not used again until the fifth session. During Session 5 the red lights were turned on for 2" during the ninth trial of that session. This was during the nineteenth fading step of the thirty step fading sequence when the subject continued to respond far into the delay period. Session 3 advanced the delay from 44" to 60". The three fading sessions, Sessions 4, 5 and 6 were each ten, 60" delay periods in length.

Subject B received the three-step preliminary training and was put on the program at 2" delay. The delay intervals were increased to 20" during Session 1. Sessions 2 through 6 were without variation to the procedure described above. Sessions 7 through 12 were each ten, 60" delay periods in length and repeated the last ten fading steps each session. The red lights were used during inappropriate responding during the fourth, sixth and tenth delay periods of Session 9, and on the sixth and eighth delay periods of Session 10. The response light was also turned off and on during the latter two periods. The red light and response light manipulation was made during delay intervals five and six of Session 11 and trials two, six and seven of Session 12.

Subject C's preliminary training was different from the other Programmed Subjects. She received 12 poker chips on a CRF schedule of reinforcement when she made single responses to the lighted response button. Concurrent with the delivery of the first poker chip, the response light darkened, a single tone sounded for ½ second, and an intertrial interval (ITI) of 1" was programmed before the response light was turned on. Each succeeding response to the lighted button was followed by an ITI that increased in length by 1". Trials were repeated when inappropriate responding occurred to the dark response button. This subject was never changed from CRF to VI 5-sec. The delay tone and flashing red lights were faded to full loudness and brightness in five steps on five additional trials with ITI's of 10". Subject C was put on the program at 2" delay, and the delay was increased to 40" with 2" increments during Session 1. Session 2 increased the delay from 42" to 60". The Experimenter omitted the session fading out the red lights. They were neither faded out or used for Subject C after Session 2. Sessions 3, 4 and 5 were the three fading sessions, each ten, 60" delay periods in length. The subject continued on a CRF plus delay schedule of reinforcement throughout all sessions. She was, in this sense, different from all other Programmed Subjects.

Subject D's parents would not permit him to work for toys; he traded his poker chips after all sessions for tokens which in turn could be exchanged for special privileges in the preschool, i.e., use of a tent, baking cookies, etc. Subject D received the three-step training described above and underwent the program as outlined, with one exception. The last 10 fading steps were presented over two sessions, each five, 60" delay periods in length, instead of in one session with ten, 60" delay periods.

Subject E had only one variation from the outlined sequence of training and programmed sessions. The last 20 fading steps were divided equally over four sessions. A nine day interval separated Sessions 7 and 8. Equipment failure postponed the sessions for two days, and S's illness for the additional time.

RESULTS

Baseline Subjects

Figure 1 shows the response curves for Baseline Subject 1. Session 1 which included the three training steps, one 120" delay period and three, 60" delay periods produced 41 responses to the lighted response button during training and to the VI schedule which preceded the four delay trials. There were 151 responses to the dark response button during training and the four

INSERT FIGURE 1 ABOUT HERE

delay periods that comprised Session 1. Five of the responses occurred during the first 2" of delay and such responses will be reported in parentheses after the total number of delay responses for each session, i.e., 151 (5) in the results of this report. Sessions 2 through 6, each ten, 60" delay periods in length, produced 12, 11, 30, 21 and 30 responses respectively to the VI schedule. Responses during delay for the same sessions were recorded at 80 (8), 54 (6), 140 (10), 238 (7) and 237 (11). The seventh session with six, 60" delay periods produced 23 responses to the VI schedule and 98 (8) responses during delay.

The cumulative curves for Baseline Subject 2 are reproduced in Figure 2. The three training steps produced 36 responses to the lighted response button and 15 responses to the dark button. Responses to the VI schedule were

INSERT FIGURE 2 ABOUT HERE

recorded at 4, 17, 18, 14, 16, 16 and 6 for the seven sessions. Responses during delay for the same seven sessions numbered 12 (1), 15 (0), 29 (4), 33 (3), 43 (12), 18 (5) and 4 (0).

Figures 3 and 3a show the cumulative records for Baseline Subject 3. Preliminary training produced 27 responses to the lighted response button and 10 responses to the dark button. There were 4 responses on the VI schedule and 13 (1) responses during the four delay periods presented during Session

INSERT FIGURES 3 & 3a ABOUT HERE

1. The succeeding five sessions, each ten, 60" delay periods in length, showed responding to the VI schedule at 46, 32, 32, 12 and 41. Responses recorded during the delay periods following each VI segment were 1048 (44), 1006 (41), 902 (38), 550 (17) and 597 (21). The last session, terminated after the sixth, 60" delay period, produced 14 responses to the VI schedule and 385 (17) during delay.

Programmed Subjects

Programmed Subject A, whose cumulative curves are reproduced in Figures 4 (Previous Study) and 4a (Present Study), was first trained for three sessions during the previous study when she received 6 poker chips on a FI 1½-sec schedule and 36 poker chips on a VI 5-sec schedule during her first session. She made 277 responses during this session. Session 2 produced 587 responses on the VI 5-sec schedule with 54 chips delivered. Delay was introduced at 2" on the first trial of Session 3, increased to 4" on trial 2 and to 6" for trials 3 and 4. The cumulative recorder was reset at this

INSERT FIGURE 4 ABOUT HERE

point, the tone volume was turned up to 50 and the circle of lights, which were white at this point, was turned on to full brightness during delay. The delay interval was reduced to 2" for four trials, increased to 4" for three trials, and to 6" for the next three, where it remained for the rest of the session. Subject A continued to respond at a high, steady rate throughout all conditions, emitting 256 responses during VI and 179 responses during delay. Thus, she was dropped as a subject for the previous study.

With the change in training conditions under the present study this subject was brought back. Session 1, in the present study for $\underline{S}_A$ consisted of the three training steps and 14 additional trials on the multiple VI 5-sec DRO 10-sec schedule. This extra training was given after three trials

INSERT FIGURE 4a ABOUT HERE

on the program with delay periods of 2" during which time the subject continued to respond. She was returned to the program after the extra training at a 10" delay and taken to 20" during Session 1. Response figures are not available for this session. Session 2, which advanced the delay intervals from 22" to 44" produced 138 responses during the VI segments of the schedule and 15 (8) responses during delay. Session 3, during which the delay interval increased from 44" to 60", responses were recorded at 117 to VI and 13 (9) during delay. The other five of the 13 inappropriate responses beyond 2" of delay in Session 3 were a continuation of VI responding (Figure 4a, Session 3). The last three sessions, with delay periods of 60", each session ten delay periods in length, faded the response light back on during delay to the same intensity as during VI, and the delay tone out. Responses recorded during the VI segments of these three sessions were 85, 127 and 80 respectively. Responses during delay numbered 13 (11), 24 (16) and 7 (7). Of the 30 delay trials in the fading sessions, there were three delay trials which contained errors; i.e., responses recorded past the first 2" of delay. One error was recorded in both trials 1 and 2 of the first fading session, and 8 on trial 9 of the second session. Close inspection of these points (Figure 4a, Sessions 4, 5) shows these errors were continuations of VI responding. Two seconds of flashing red lights were presented during inappropriate responding during trial 9, Session 5, when a continuation of VI responding went far into the delay period.

Figures 5 and 5a depicts the response curves for Programmed Subject B, who made 75 responses to the lighted response button during Session 1, and 7 (7) responses to the dark button during training and delay. Sessions 2 and 3,

INSERT FIGURES 5 & 5a ABOUT HERE

when the delay intervals were increased from 22" to 60" recorded 79 and 55 responses to the VI schedule with 4 (4) and 2 (2) responses during delay. There were 63 responses to VI and 6 (6) responses during delay for Session 4 when the red lights were faded out of delay in ten steps. Sessions 5, 6 and 7; the fading sessions; produced 66, 88 and 86 responses to the VI schedule and 11 (7), 16 (10) and 228 (14) responses during delay. Sessions 8 through 12, when fading steps 21 through 30 were repeated five times, tallied 64, 88, 37, 47 and 50 responses to VI and 71 (7), 29 (15), 60 (3), 17 (2) and 28 (3) responses during the delay intervals.

Figure 6 duplicates the cumulative curves for the five sessions for Programmed Subject C (who was on CRF for the entire experiment). This subject made 21 responses to the lighted response button and 6 responses to the dark response button during training, and 20 responses to CRF and 0 responses during the 20 delay periods ranging from 2" to 40" during Session 1. Session 2, with delay periods increasing in 2" increments from 42" to 60" over ten

INSERT FIGURE 6 ABOUT HERE

trials produced 10 responses to CRF and 0 responses during delay. The three fading sessions, Sessions 3, 4 and 5, each recorded 10 responses to initiate the ten, 60" delay periods. There were 0 responses during delay for Session 3. Three errors were recorded for Session 4, one each in trials 2, 3 and 9. Twenty-seven responses occurred during delay in Session 5, with only trials 5, 7 and 9 being void of inappropriate responses. Responses occurring during the first 2" of delay are not available for this S, nor would they be appropriate since she was on a CRF rather than a VI schedule.

Figure 7 shows the cumulative records for Subject D who made 39 responses during the three-step training program to the lighted response button and 3 responses when the button was dark. He was put on delay at 10" and advanced to 20" during Session 1, and emitted 46 responses to VI and 0 responses during

INSERT FIGURE 7 ABOUT HERE

delay. Session 2 produced 83 VI responses and 4 (4) responses during delay as the delay was increased from 22" to 44" in twelve steps of 2" each. The interval between trials 1 and 2 (noted by asterisk on Figure 7) marks a period when S was asked not to respond while E replaced a bulb that had burned out in the readout unit. Session 3 increased delay from 46" to 60". VI responses for this session totaled 58, with 1 (1) response during delay. The red lights were faded out in ten equal steps in ten trials during Session 4. There were 80 responses during the VI portions of this session and 6 (1) responses during delay. The S talked with an S in the next booth during the last trials of this session. Session 5 was the first fading session. There were ten fading steps each in Sessions 5 and 6, and five fading steps each in Sessions 7 and 8. Responses during VI were 73, 64, 40 and 21. Delay responses for the four sessions were recorded at 4 (4), 101 (3), 60 (0) and 65 (1). Delay responses occurred during trials 5, 7, 8, 9 and 10 in Session 6 and trials 1, 4 and 5 of Session 7. The red lights were turned on at full brightness for two, 3" periods when errors occurred in trial 4 of Session 7, and again for about 45" during trial 5. They were used during trials 1, 2, 3 and 5 of Sessions 8.

Figure 8 is the cumulative record of Subject E. There were 54 responses to the lighted response button during the three-step training sequence and 15 responses to the dark button. S was put on the program during the first session at a 10" delay and advanced to 20". There were 14 responses to VI

INSERT FIGURE 8 ABOUT HERE

and 0 responses during delay. Session 2, which increased the delay periods from 22" to 44" in twelve trials, recorded 51 VI responses and 3 (2) delay responses. The one response past the first 2" of delay occurred during the 40" delay trial. The third session produced 32 VI responses and 12 (1) delay responses with two errors occurring during the 54" trial, and 9 errors during the 60" trial. Session 4 faded the red lights to off in ten steps and the subject emitted 19 responses to the VI condition and 3 (1) responses during delay. The errors occurred during the sixth and tenth trials. The thirty fading steps were divided over five additional sessions, with ten in Session 4 and five in each of the last four sessions. Responses during the VI schedule were recorded at 32, 20, 8, 9 and 8. Errors numbered 11 (0), 16 (0), 9 (1), 21 (1) and 9 (0).

Figure 9 is a graphic analysis of the percent of the total responses for each session which occurred during the delay periods for all subjects. The data were calculated by dividing the delay responses each session by the total number of responses for that session.

INSERT FIGURE 9 ABOUT HERE

The graph to the left gives individual data for the Baseline Subjects across sessions. The graph to the right gives the same data for the Programmed Subjects. Their comparison shows in general, that Programmed Subjects had a lower percent of total responses during delay than did Baseline Subjects, particularly in the first four sessions. The curves of two Baseline Subjects did not overlap with the Programmed Subjects; they always had a higher percentage of total responses during delay.

It is apparent the Programmed Subjects made a larger percentage of their total responses during delay in the last sessions of the experiment, whereas the Baseline Subjects tended to show an overall high distribution of delay responses. Programmed Subject A's highest percentage of delay responses occurred during Session 5, when 16% of her responses occurred during delay. This was in fading steps 11 through 20. Delay responses of Programmed Subject B did not go above 15% until Session 7, when they totaled 73% for fading steps 21 through 30. These fading steps were repeated in Sessions 8 through 12, and delay responses fluctuated between 25% and 62%.

Programmed Subject C did not make a delay response until the last two sessions, Sessions 4 and 5. Session 4, which presented fading steps 11-20, shows 23% of total responses occurring during delay. Session 5, with fading steps 21-30, had 73% of total responses occurring during delay. This subject was on CRF. Therefore never more than one response for each trial was recorded outside the delay interval.

Programmed Subject D did not rise above 6% delay responses until Session 6 when fading steps 11 through 20 were presented. His delay responses for that session were 61% of total responses. Sessions 7 and 8, each five, 60" delay periods in length, with fading steps 21 through 30 presented, had delay responses 60% and 76% of total responses.

Programmed Subject E, after low first and second session errors, made 27% of total responses during delay in Session 3 during which delays were increased from 46" to 60". Session 4 showed under 15% delay responses, but Sessions 5 through 9 with fading steps 1 through 30 had delay response percentages between 26 and 70.

Baseline Subjects 1 and 3 had delay responses which were between 76% and 98% of total responses over all sessions. Baseline Subject 2, who was a low responder under all conditions, had delay response percentages between 40 and 73.

An analysis of errors during the thirty fading steps for both studies is shown on Figure 10. The data was analyzed by computing median responses

INSERT FIGURE 10 ABOUT HERE

during delay fading steps for Programmed Subjects 1, 2 and 3 for the previous study; and Subjects A through E for the present study. The graphs represent the same fading steps for each subject, however, the number of fading steps per session, the use of red lights during delay, and response button light manipulation as noted under Procedure varied between subjects. For both studies it appears that up to fading step 24 the median number of responses during delay is comparable. It should be recalled that the terminal fading steps (response light and tone) are near completion and approaching the criterion conditions for delay at this time. The curves for the two studies, beginning at step 24 differ. Subjects in the present study emitted many more delay responses than subjects in the previous study.

Figure 11 is an analysis of the latencies of the response to VI after delay ended for both Baseline and Programmed Subjects. This is the time

INSERT FIGURE 11 ABOUT HERE

interval from reinforcement (which occurs at the end of the delay period) until the Subject's first response to the lighted response button which marks the beginning of the VI schedule. The latency measure gives an indication of the precision of the discrimination of when it is appropriate to respond.

The latency measure was made with a millimeter rule. The distance between the marks made by the event pen when it was projected upward (marking the start of VI) and then downwards (marking the start of delay) was measured. Therefore, latency measures include both the VI 5-sec interval and the time from reinforcement and the time the first VI response occurred. Since the VI tape averaged 5-sec over nine intervals, each subject probably had the same random number of seconds in overall VI time. A reliability check of the latency was carried out by the Experimenter and one other person making independent latency measurements. Agreement over all latency period measurements was 93% (no. of agreements/total no. of latency measurements).

The top graph shows the mean of the latencies per session for the three Baseline Subjects. The middle graph shows the mean latencies for Programmed Subjects A, B and C; and the bottom graph for Programmed Subjects D and E.

Of the total of 40 sessions plotted for the five Programmed Subjects, only seven sessions had mean latencies longer than five seconds. Twenty of the 21 sessions for Baseline Subjects had latencies longer than five seconds. The curve for Baseline Subject 3 is similar to the curves of the Programmed Subjects. However, this subject had a fairly steady high rate of responding regardless of the condition in effect. Therefore, latencies would be low.

DISCUSSION

Programmers often find that some subjects do not emit behaviors that are prerequisite for a particular program. This deficiency in the behavior repertoire is usually manifest through a high incidence of errors in the beginning stage of the program, especially when repeated attempts to shorten sessions, change reinforcers, and/or rearrange the program lead to little success. Programmers, because of this, often specify rather explicit prerequisite behaviors a subject must have to be considered eligible for a particular sequence of training.

The major difference between this study and the previous study was in the preliminary training prior to the delay conditions. Six of the nine subjects in the first study were discontinued during the initial delay conditions. They continued to respond during delay in the same manner as they did under the VI schedule, making many errors in the initial phases of the program. This suggested that at least one prerequisite behavior necessary for initial success on the program was lacking. Another possible reason for the errors could have been that the training on FI 1½-sec and VI 5-sec schedules resulted in a fairly steady responding—behavior incompatible with response-pause-reinforcement chains critical to the results desired under the program. Consequently, training under the FI and VI schedules was discontinued, and the three-step preliminary training procedure designed to build pause behavior was instigated.

Only one Programmed Subject out of a total of nine subjects in the present study did not make the necessary initial discrimination of responding during response light-on and not responding during light-off and tone-on. This was an increase from 33% to 89% of randomly selected subjects who met the initial prerequisite behavior for continuing on the delay program. Appendix I gives information on all subjects, their sex, age and reason if discontinued for both studies. The three-step training procedure given to both Baseline and Programmed Subjects in this study appeared to be an effective method of establishing pause-building under the no-light condition prior to implementing the experimental conditions of programming or no programming. Although pause behavior was an essential prerequisite to the program of teaching no-responding during a one-minute delay of reinforcement, apparently it was not sufficient training in itself for the behavior without the program. The Baseline Subjects with pause-building pretraining did not subsequently learn to wait during delay for reinforcement.

The comparison between Baseline and Programmed Subjects in the percentage of total responses made during delay indicated the program was quite effective for acquisition of no-response during a 60" delay of reinforcement, and was adequate to maintain this behavior during the early fading steps. However, even though the Programmed Subjects emitted a lower percentage of total responses during the later fading steps than the Baseline Subjects, the program was not adequate to produce the behavior desired with this stimulus control procedure and still keep errors to a minimum. As long as visual and auditory stimuli were present, these preschool children could acquire and maintain a waiting response for one minute. But when the stimuli for not responding were absent, or were only slightly different from stimuli for responding, or when the length of the delay was not systematically increased, these children did not display this behavior.

The data gathered across the 30 fading steps for both studies show that subjects of the previous study emitted fewer delay responses during the final fading steps. However, another interpretation is possible. It could be that the subjects who were eventually programmed in the first study (not discontinued because of lack of pausing behavior) were those who had acquired a waiting response from their natural environment prior to participation in this study.

A comparison between the Baseline and Programmed Subjects of the current study, in latency of response following delay indicated that auditory and visual stimuli combined with the sequential lengthening of delay periods resulted in a closer discrimination of when and when not to respond. Baseline Subject 2 may have made the discrimination of when not to respond because of his low response rate during delay. But it was clear from the mean latency data that he had not made the opposite discrimination of when to respond. He had the longest overall latencies of any subject.

The discrimination of not responding during delay broke down for most Programmed Subjects at about the 24th fading step. At this point in the program, the tone was faint and present for 12" of the total 60". The brightness of the response light during delay was approaching the brightness associated with VI. Several procedures were employed to overcome the difficulty, none of which was uniformly successful. One manipulation, flashing the red lights (after they had been totally faded out) during periods of inappropriate responding, was very effective for one subject. A single brief presentation stopped the responding and this subject finished the program successfully. With two other subjects, however, the use of the red lights during the fading sessions was effective in stopping delay responding only while they remained on. They did not control non-responding for the remainder of the delay period during which they had been presented, or during subsequent fading sessions.

Manipulation of the response button during delay responding was also successful in stopping responding during delay as long as the response button remained off, or dim. Responding during delay resumed, however, as the brightness increased back to the value programmed for the last fading steps.

Repetition of the last ten fading steps in five additional sessions was given to one subject. It reduced errors from 214 recorded for the first presentation to 15 for the fifth presentation, but errors rose to 25 the sixth session. We might conclude from this, and from the repetitions in the previous study that repetition in itself, while improving performance, was not a sufficient training procedure to eliminate all errors in this type of discrimination learning.

The length of the fading sessions was reduced to half for two subjects. The shortened total time per session, with a corresponding shortened time in delay, did not improve the performance during the latter fading steps.

While the constant tone and light flash at the end of the VI were present throughout all sessions to mark the start of delay, there is no guarantee, as Hively (1962) and Sidman and Stoddard, (1966) have suggested, that the subjects attended to them, or to the delivery of the poker chip as a signal to begin responding. If the subjects were using the brightness of the response light and/or the intermittent tone as discriminative stimuli, we may have taught them to ignore the only stimuli that were available in the last fading steps.

The flashing red lights were inadvertently omitted for two subjects prior to the session they were scheduled to be faded out of the delay periods. From the subsequent performance of these two subjects we can conclude that the lights were not a necessary additional stimulus to control no-responding during the acquisition of a 60" wait for reinforcement.

In summary, pause behavior appeared to be a necessary prerequisite to a successful entry into the program for teaching a 60" wait for reinforcement, with no responding during the delay. The three-step preliminary training was successful with almost all preschool children used in this study in teaching pause behavior. A gradual lengthening of the delay period over successive trials to 60" with a distinctive visual stimulus for periods when responding was appropriate; and both visual and auditory stimuli when it was not; worked well for all subjects. When the stimuli that were discriminative for not responding were faded out of the delay periods, most subjects experienced difficulty in maintaining the discrimination during the last fading steps of the program. Future research in this area will be directed to this problem.

One approach to developing a time discrimination could be to use an auditory counting stimulus, such as a human voice. The voice would start with one and count in sequence to sixty, with one number vocalized each second, during delay.[2] This stimulus could be faded out on one or more dimenstions; i.e., duration and/or intensity.

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Sidman, M. and Stoddard, L. T. Programming perception and learning for retarded children. In N. R. Ellis (Ed.) International Review of Research in Mental Retardation, Vol. II. New York: Academic Press, 1966.

FOOTNOTES

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[2]The authors acknowledge the contribution of this suggestion by Dr. Donald M. Baer.

APPENDIX 1
SUBJECTS

PREVIOUS STUDY

Baseline	Sex	Age	Baseline Ss Discontinued	Sex	Age	Reason Discontinued
A	M	4-11	a	F	3-7	S refused to engage in experiment
B	M	4-1	b	M	4-0	Didn't have 2 days VI stable responding
C	F	3-10	c	F	3-10	S refused to engage in experiment
D	M	5-3	d	M	4-4	S refused to engage in experiment
E	M	4-0	e	M	4-7	Parents interrupted session
			f	F	4-8	Equipment failure
			g	F	4-6	S refused to engage in experiment

Programmed Ss Used	Sex	Age	Programmed Ss Discontinued	Sex	Age	Reason Discontinued
1	F	4-10	h	M	4-3	High responder
2	M	4-9	i	F	4-1	High responder
3	F	3-11	j	M	4-8	High responder
4	F	3-10	k	F	4-8	High responder
			l	F	3-8	High responder

PRESENT STUDY

Baseline Ss Used	Sex	Age	Baseline Ss Discontinued	Sex	Age	Reason Discontinued
1	F	3-11				
2	M	5-3	None			
3	F	4-4				

Programmed Ss Used	Sex	Age	Programmed Ss Discontinued	Sex	Age	Reason Discontinued
A	F	4-10	m	F	4-10	No pause behavior
B	M	3-11				
C	F	3-7				
D	M	5-4				
E	M	4-2				

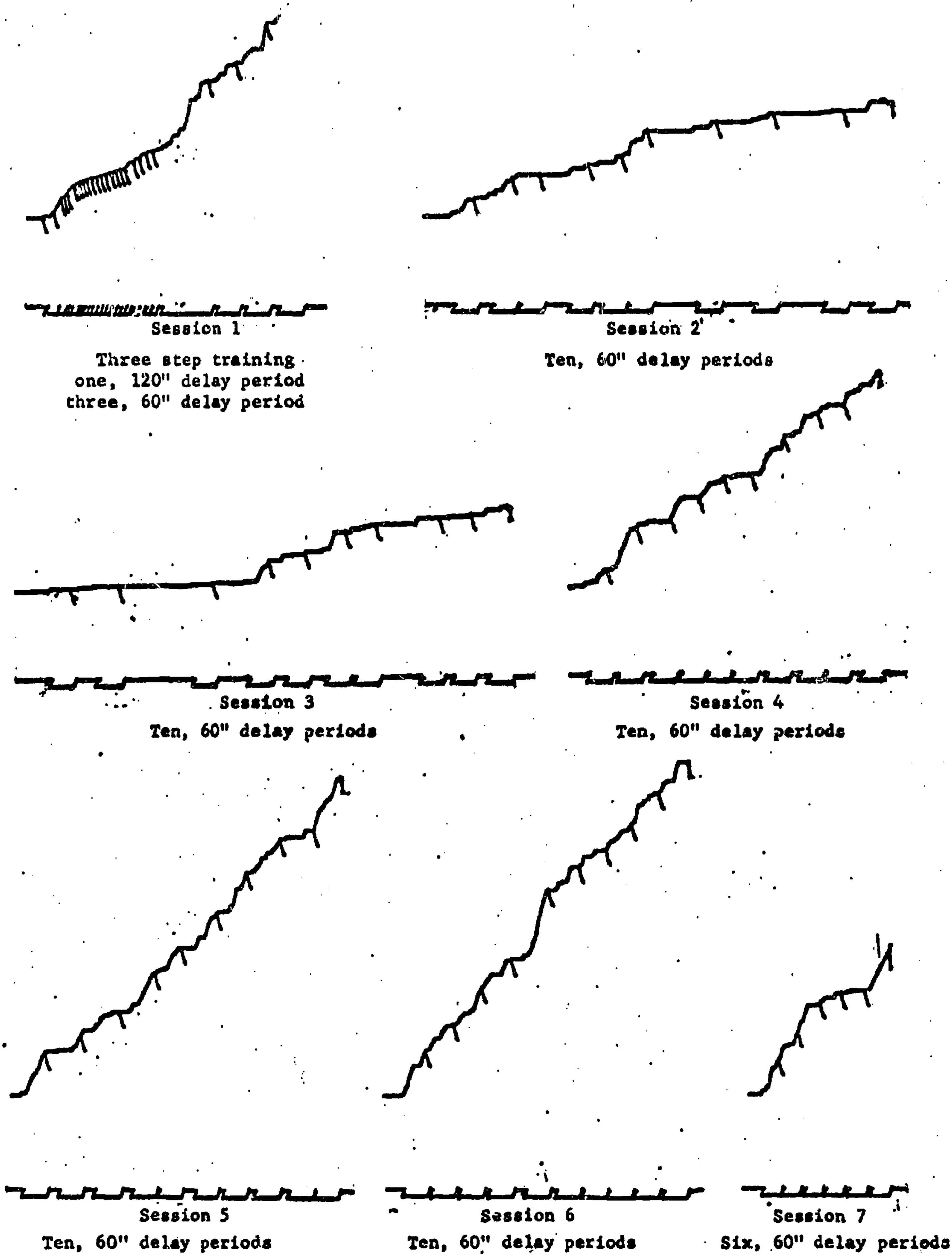


Fig. 1. Baseline Subject 1. Cumulative response curves for all sessions.

Figure 2

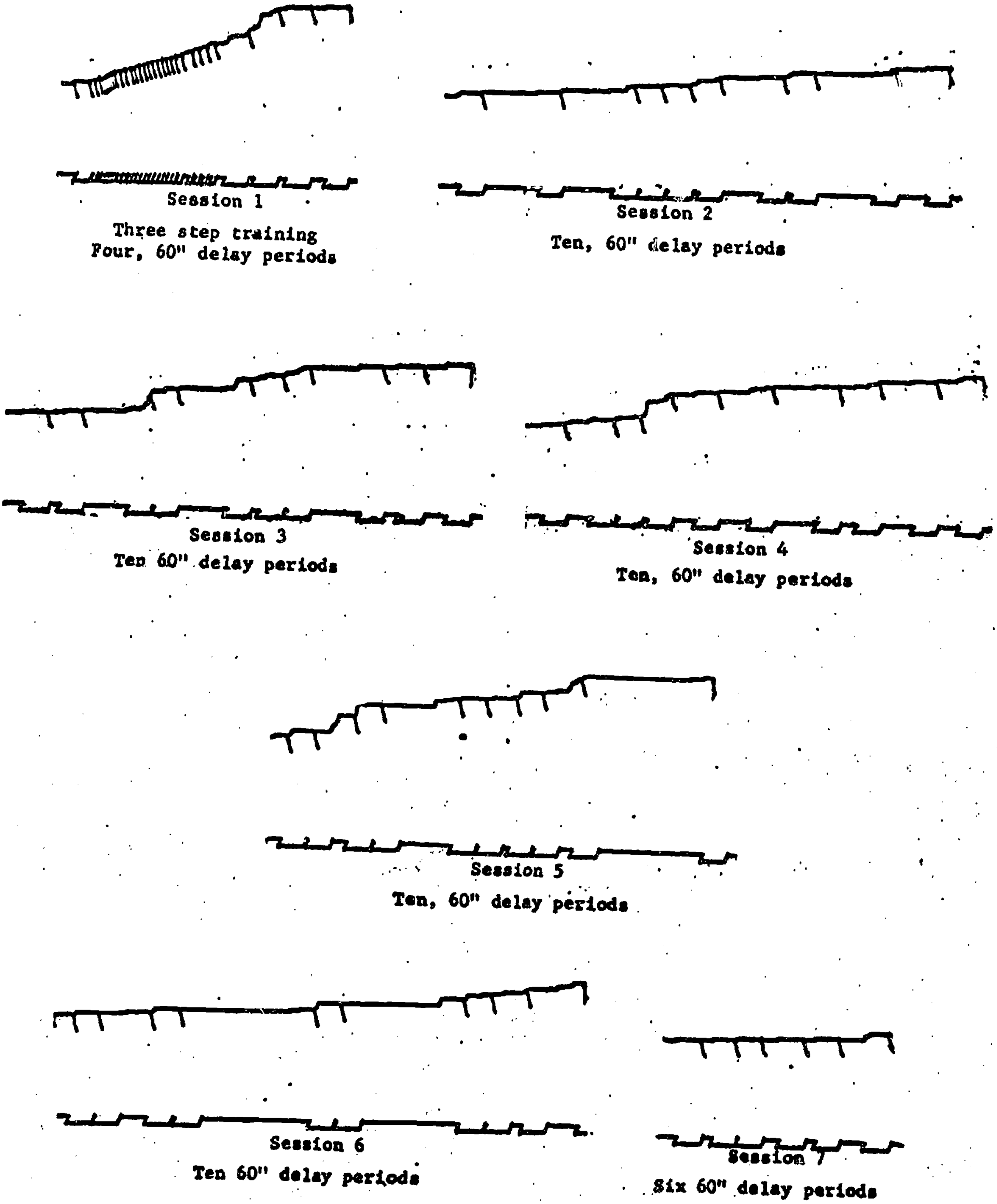
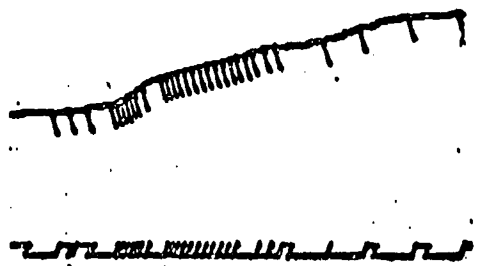
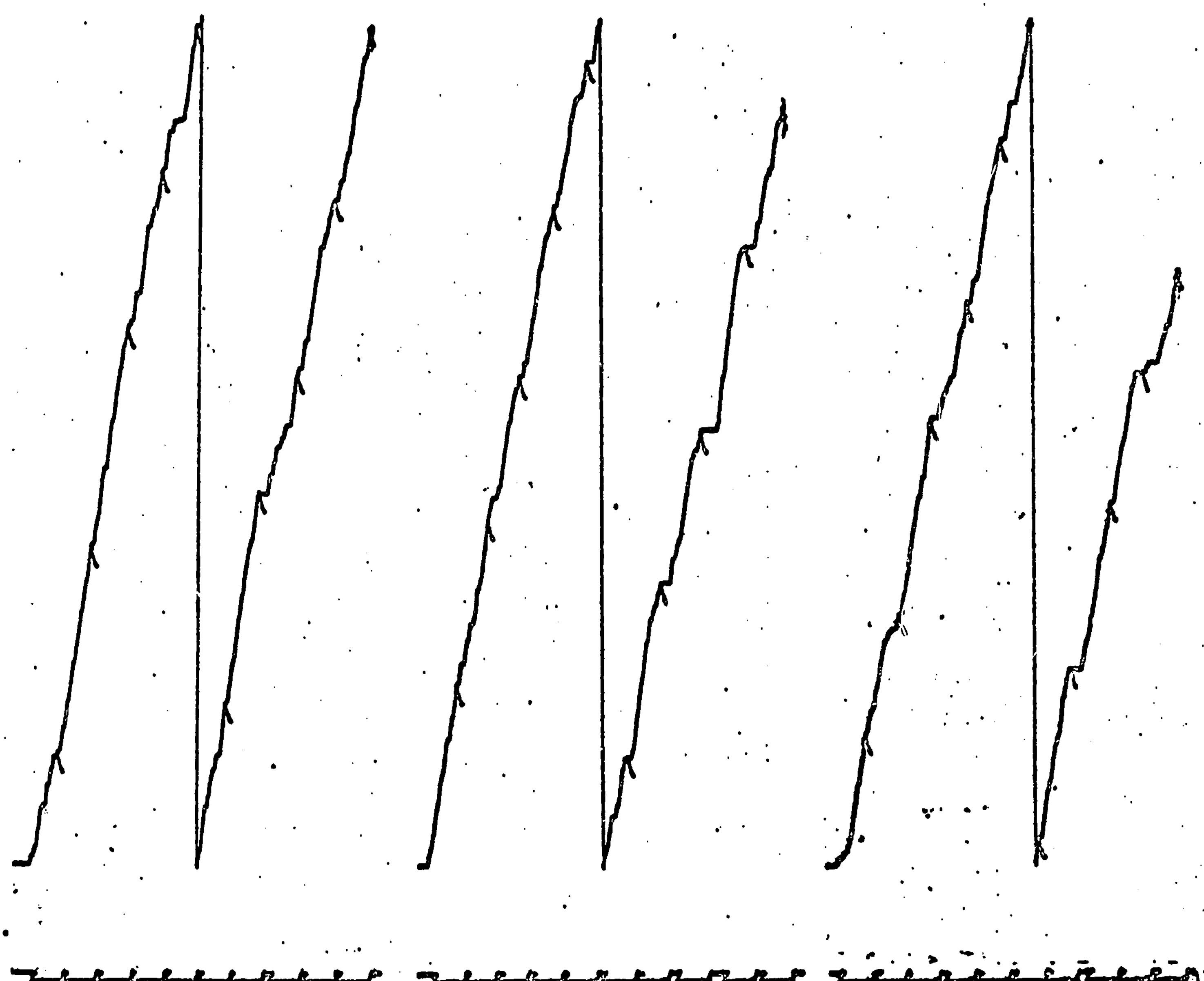


Fig. 2. Baseline Subject 2. Cumulative response curves for all sessions.



Session 1

Three step training and four, 60" delay periods



Session 2 — Ten 60" delay periods

Session 3 — Ten, 60" delay periods

Session 4 — Ten, 60" delay periods

Fig. 3. Baseline Subject 3. Cumulative response curves for Session 1, 2, 3, and 4.

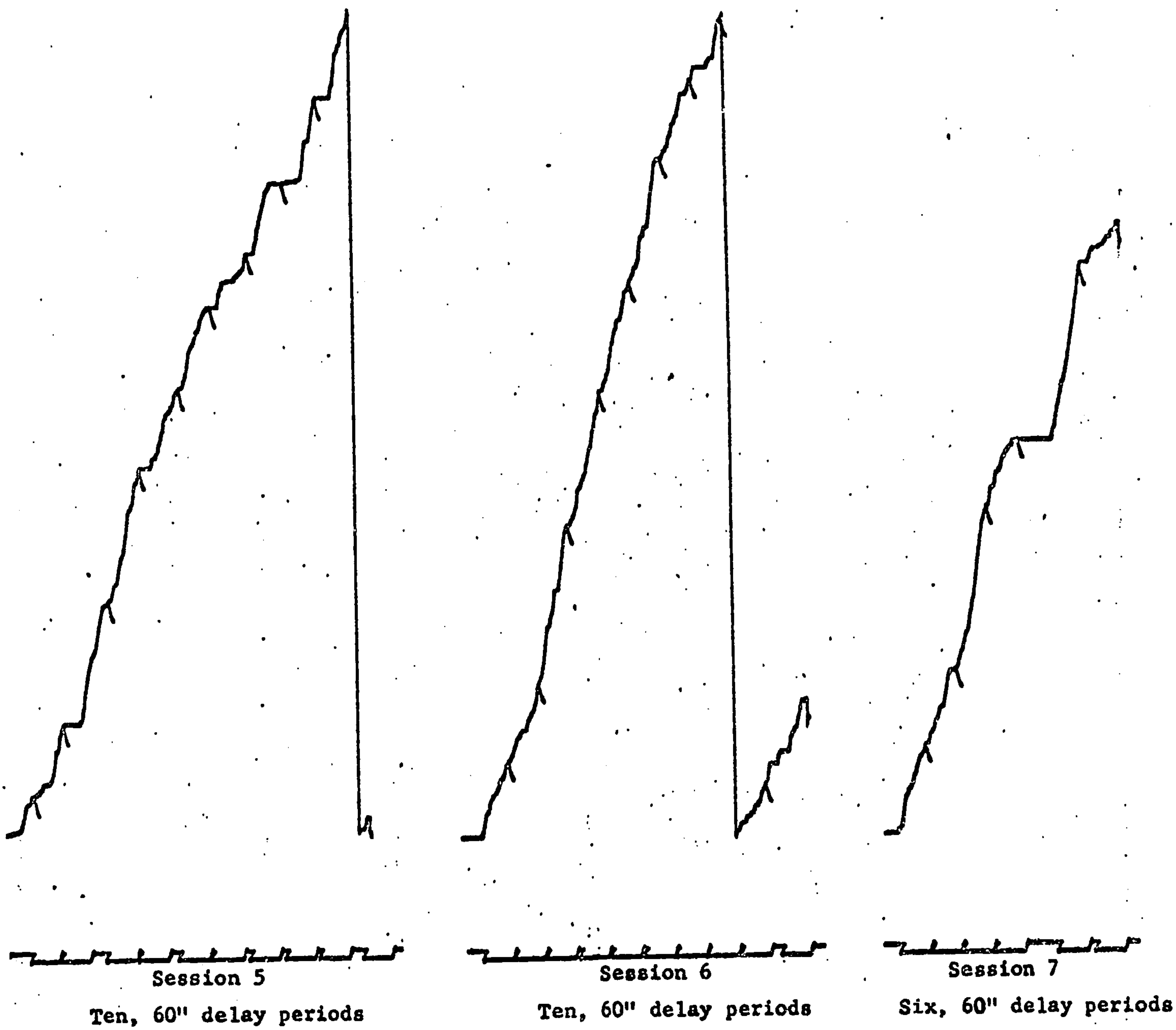
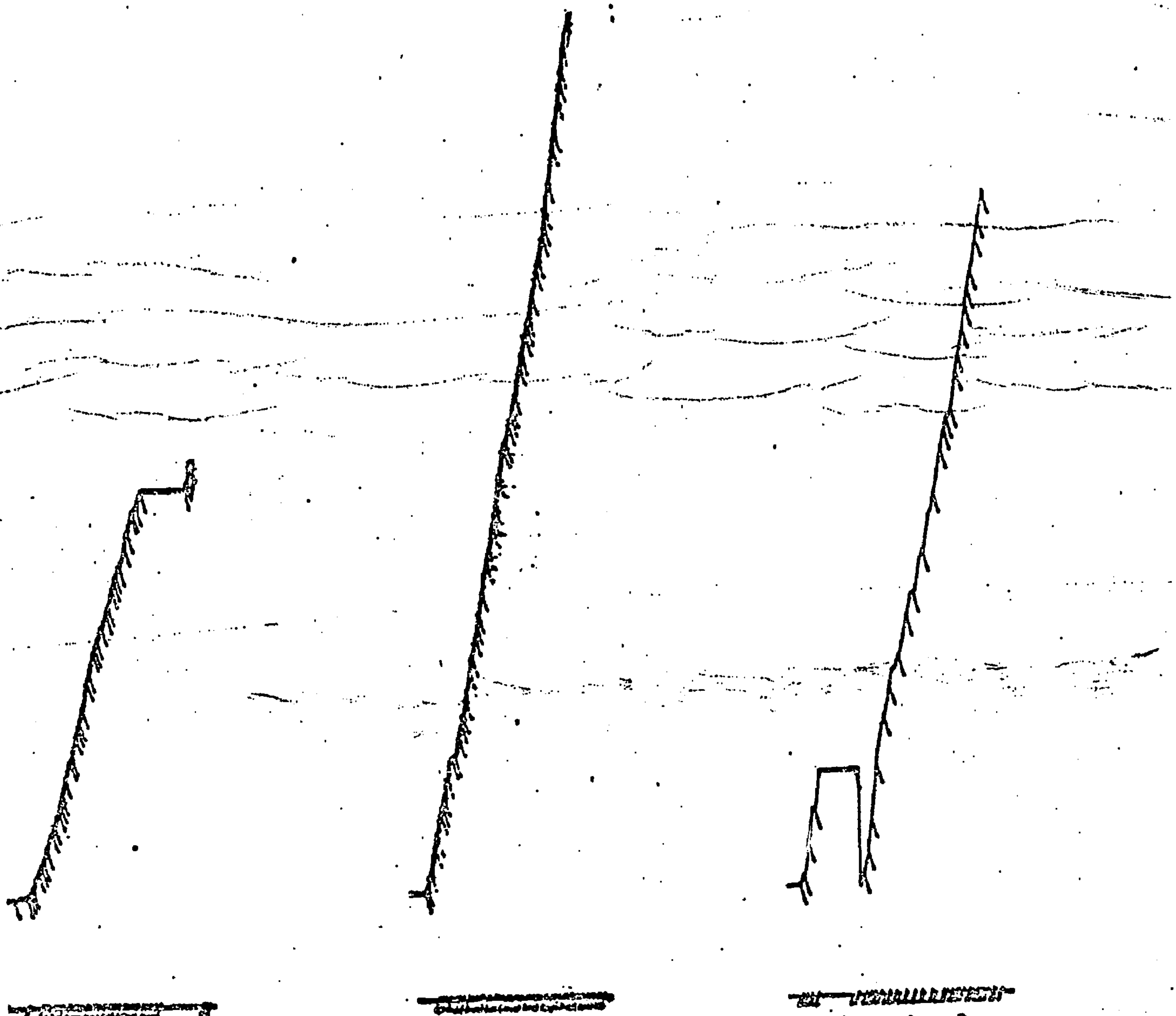


Fig. 3a. Baseline Subject 3 continued. Cumulative response curves for Sessions 5, 6 and 7.

Figure 4



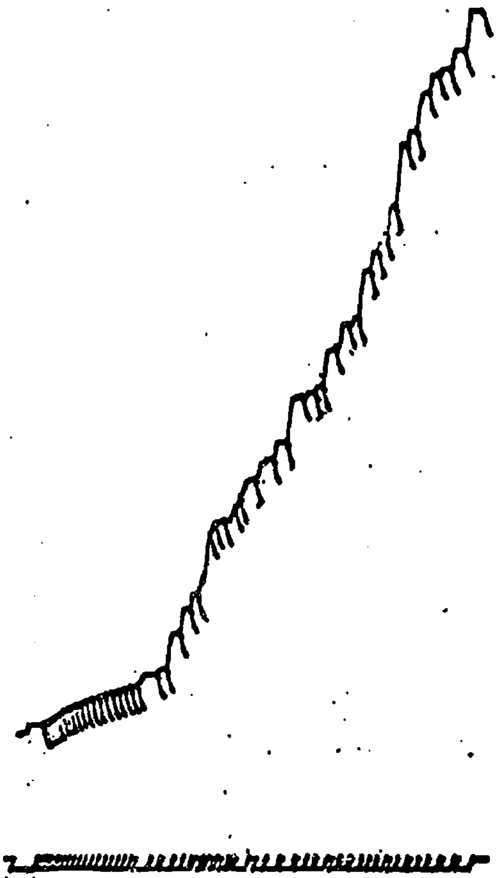
Session 1
FI 1½-sec
VI 5-sec

Session 2
VI 5-sec

Session 3
2" - 6" Delay periods

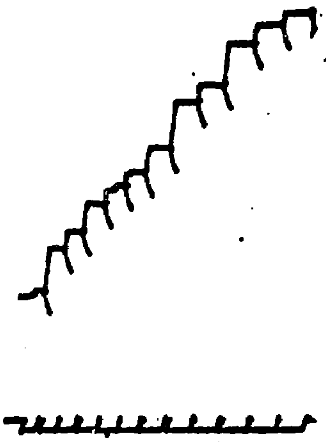
Fig. 4. Programmed Subject A. Cumulative response curves. Previous Study (Kolb, Etzel, 1967).

Figure 4a



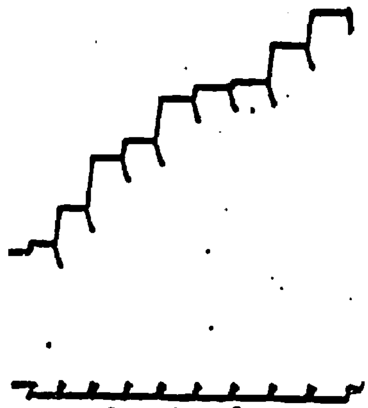
Session 1

Three step Training
Fourteen trials VI 5-sec
10" - 20" delay



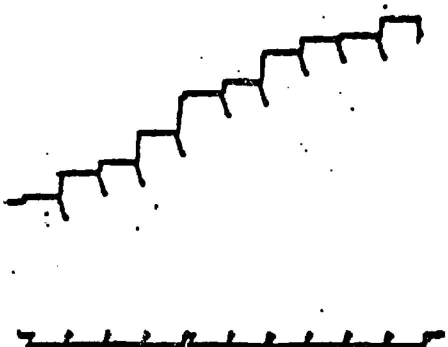
Session 2

22" - 44" delay



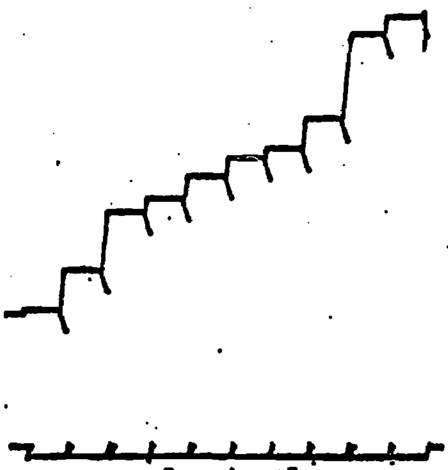
Session 3

44" - 60" delay



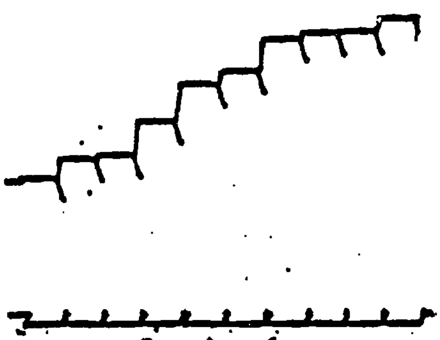
Session 4

Ten, 60" delay period
Fading Steps 1-10



Session 5

Ten, 60" delay periods
Fading Steps 11-20



Session 6

Ten, 60" delay periods
Fading Steps 21-30

Fig. 4a. Programmed Subject A continued. Cumulative response curves for all sessions.

Figure 5

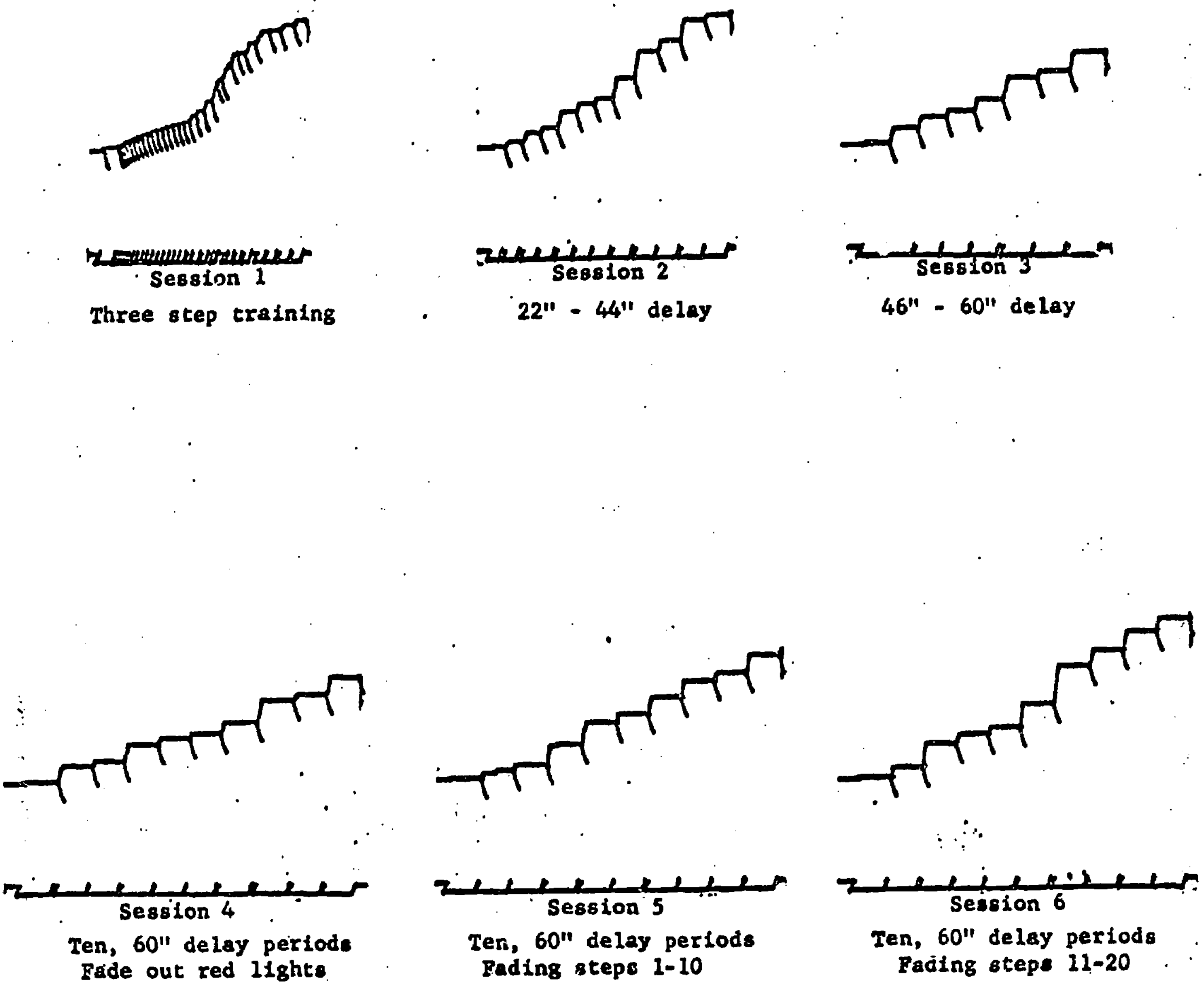
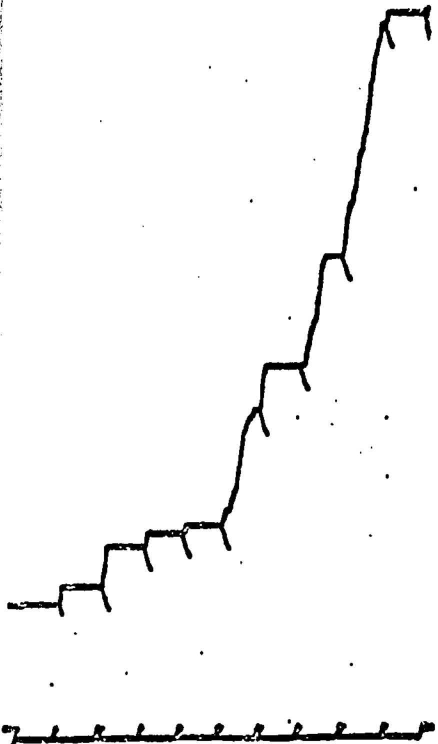
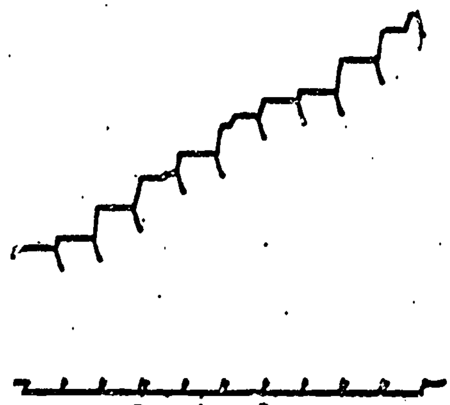


Fig. 5. Programmed Subject B. Cumulative response curves for sessions 1-6.

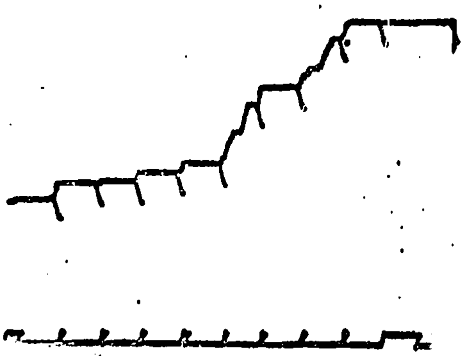


Session 7
Fading steps 21-30

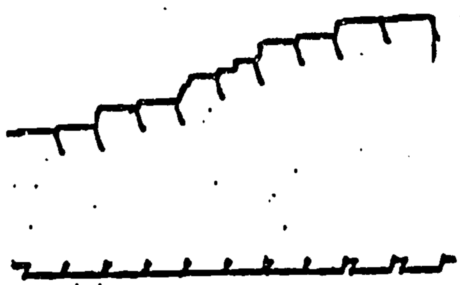
Session 8
Fading steps 21-30



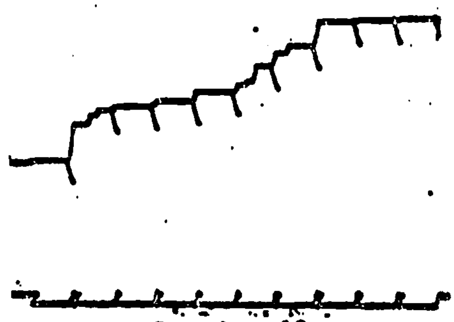
Session 9
Fading steps 21-30



Session 10
Fading steps 21-30



Session 11
Fading steps 21-30



Session 12
Fading steps 21-30

Fig. 5a. Programmed Subject B continued. Cumulative response records for sessions 7-12.

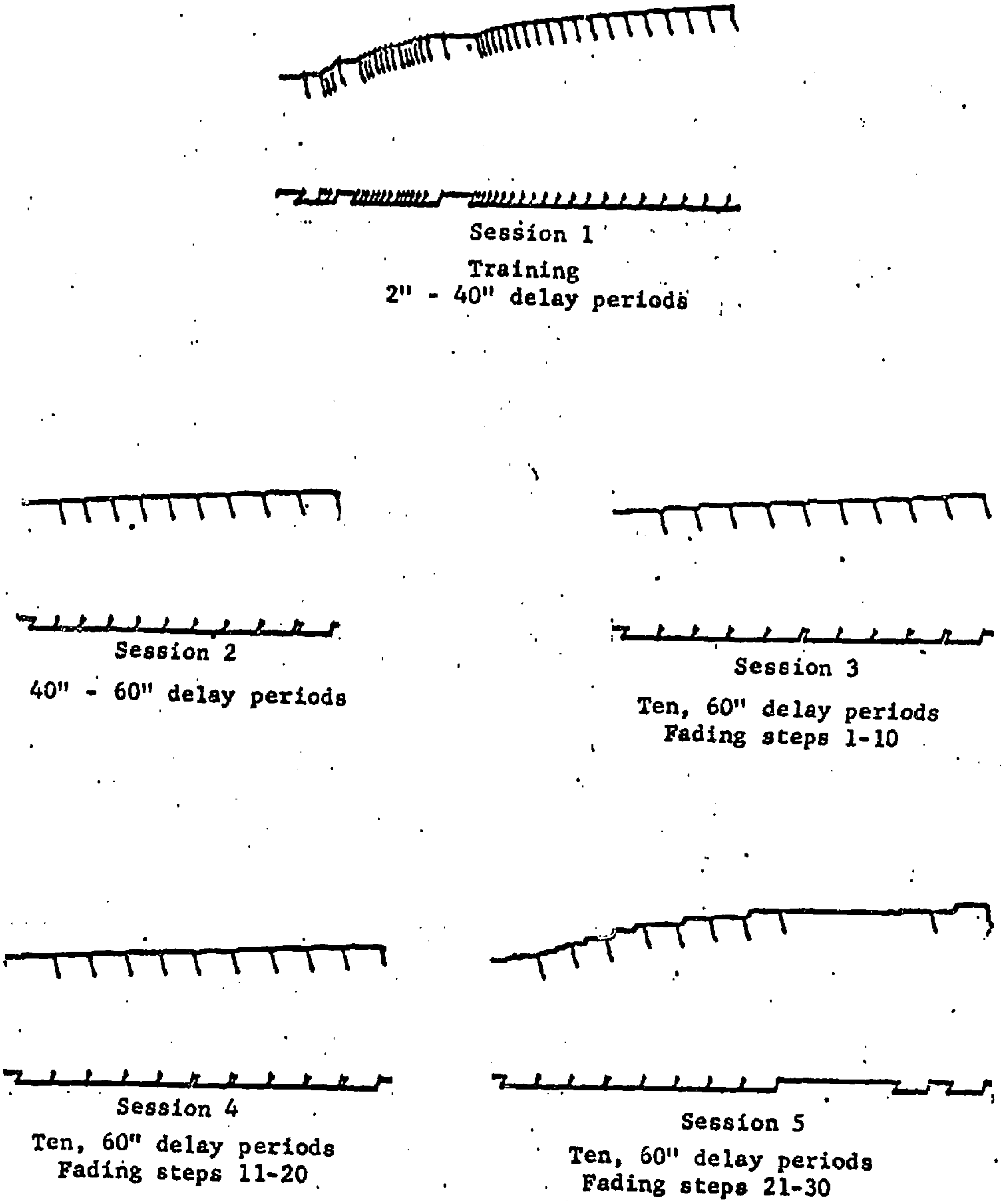


Fig. 6. Programmed Subject C. Cumulative response curves for all sessions.

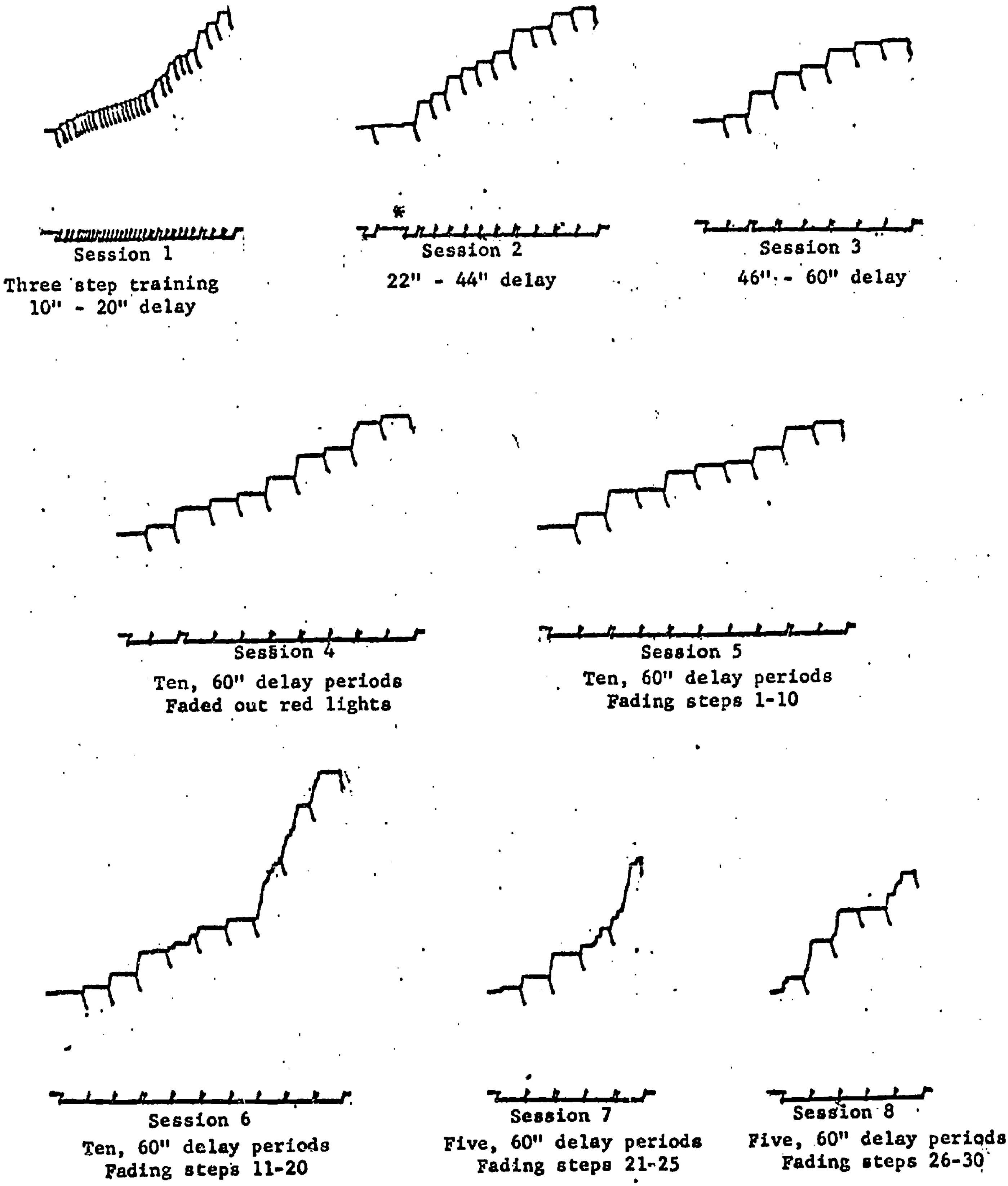


Fig. 7. Programmed Subject D. Cumulative response curves for all sessions.

*Light bulb changes

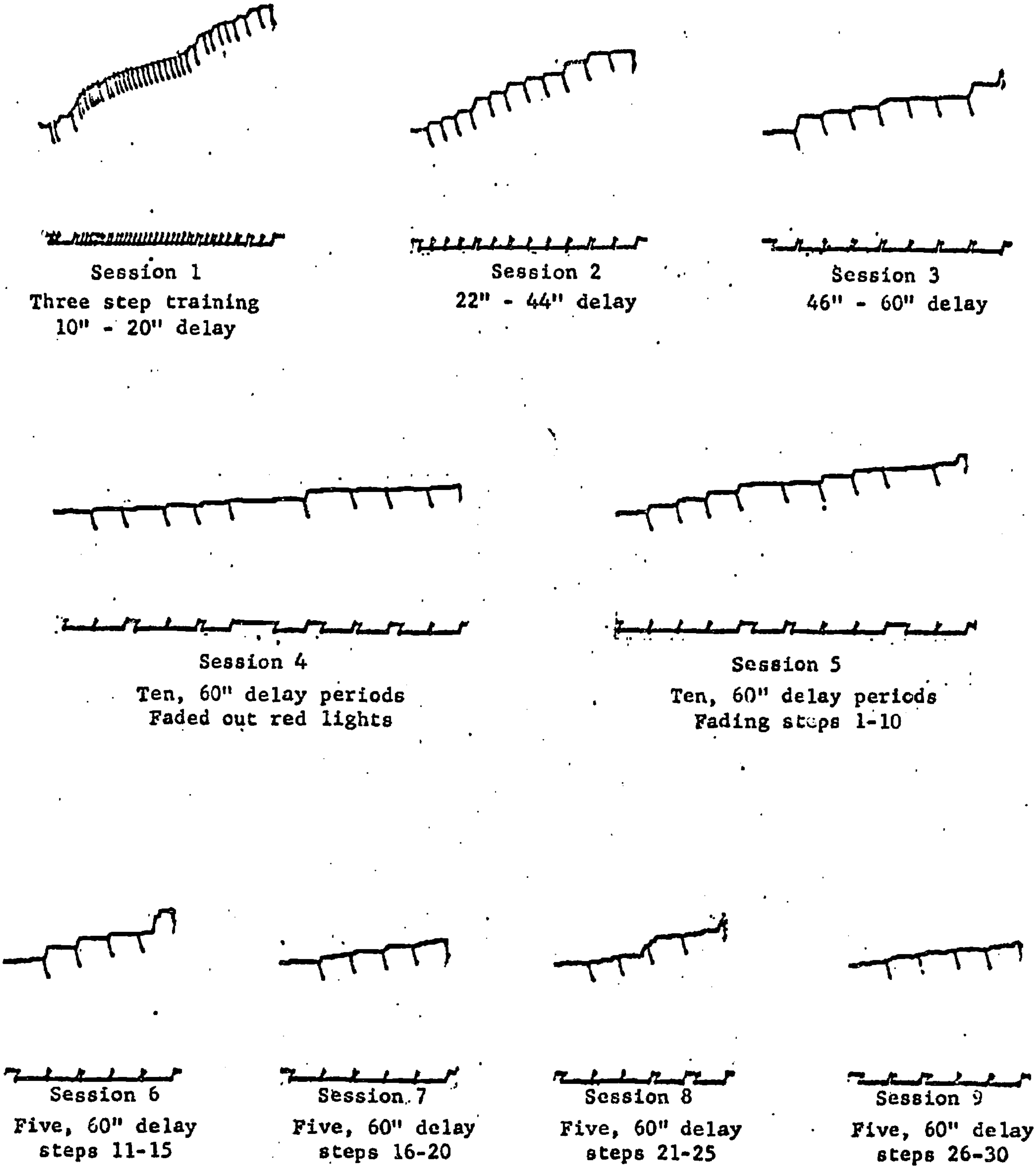


Fig. 8. Programmed Subject E. Cumulative response curves for all sessions.

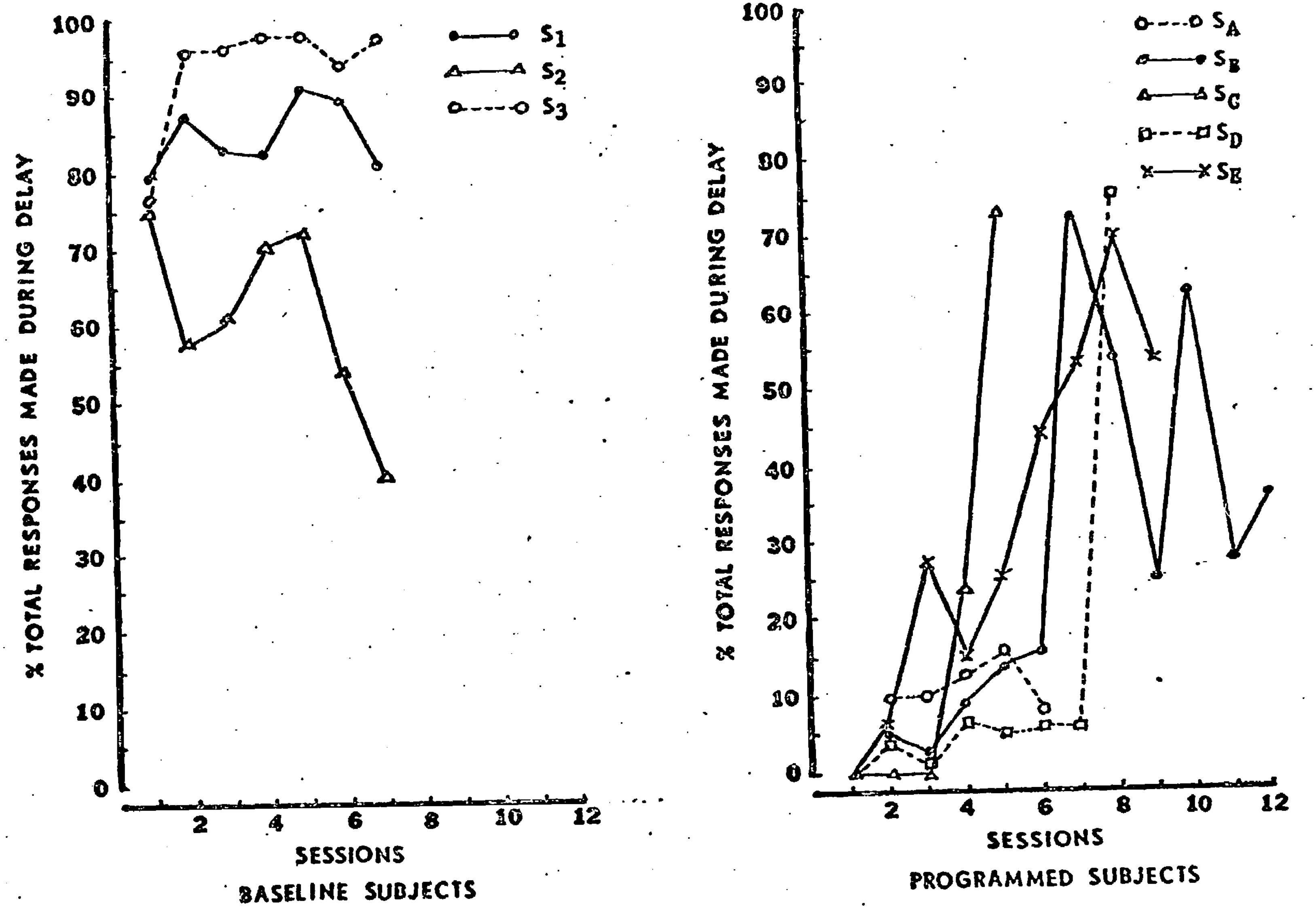


Fig. 9. Percent of total responses occurring during delay for each session.

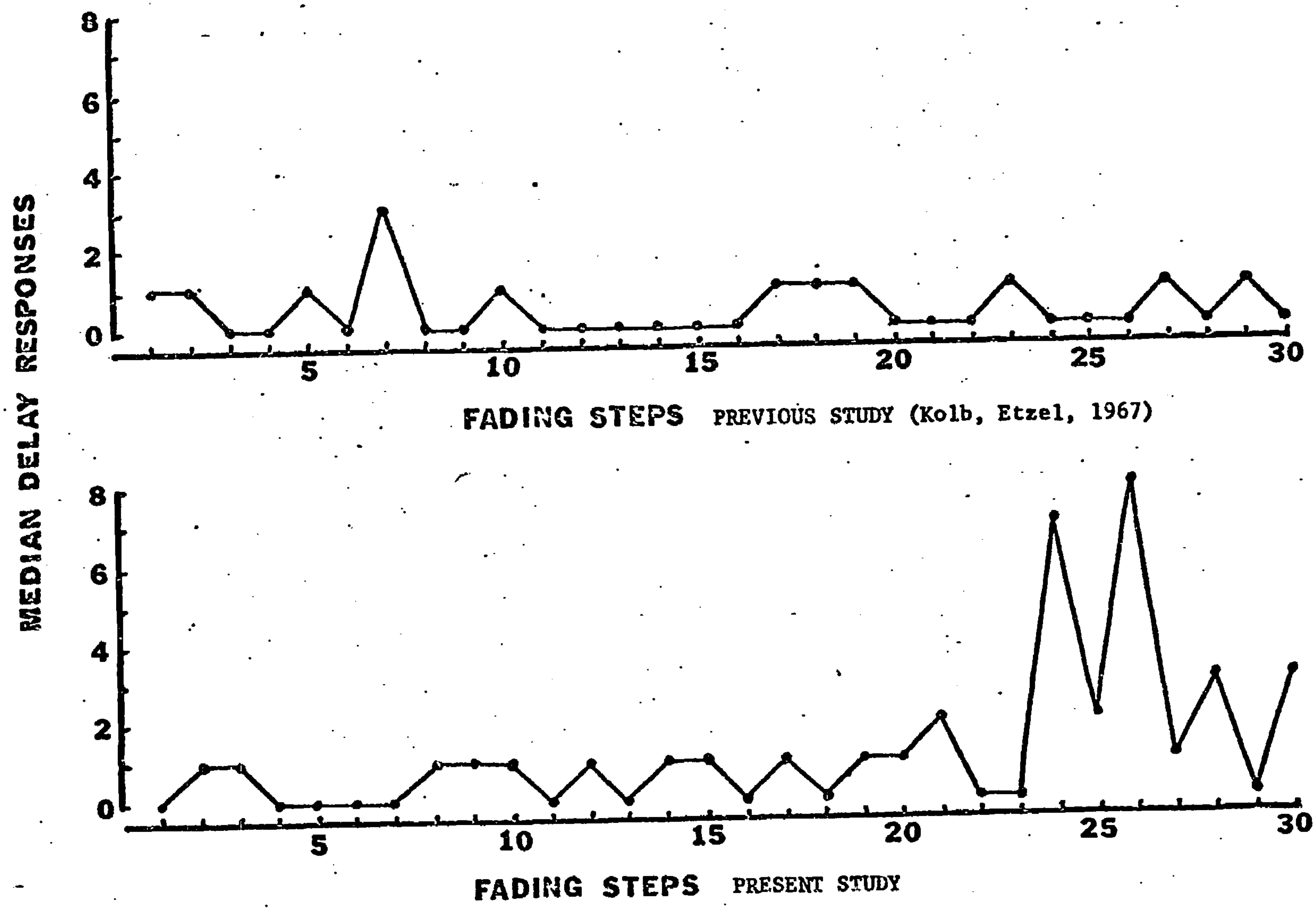


Fig. 10. Median delay responses during 30 fading steps. Programmed Subjects, Previous and Present Studies.

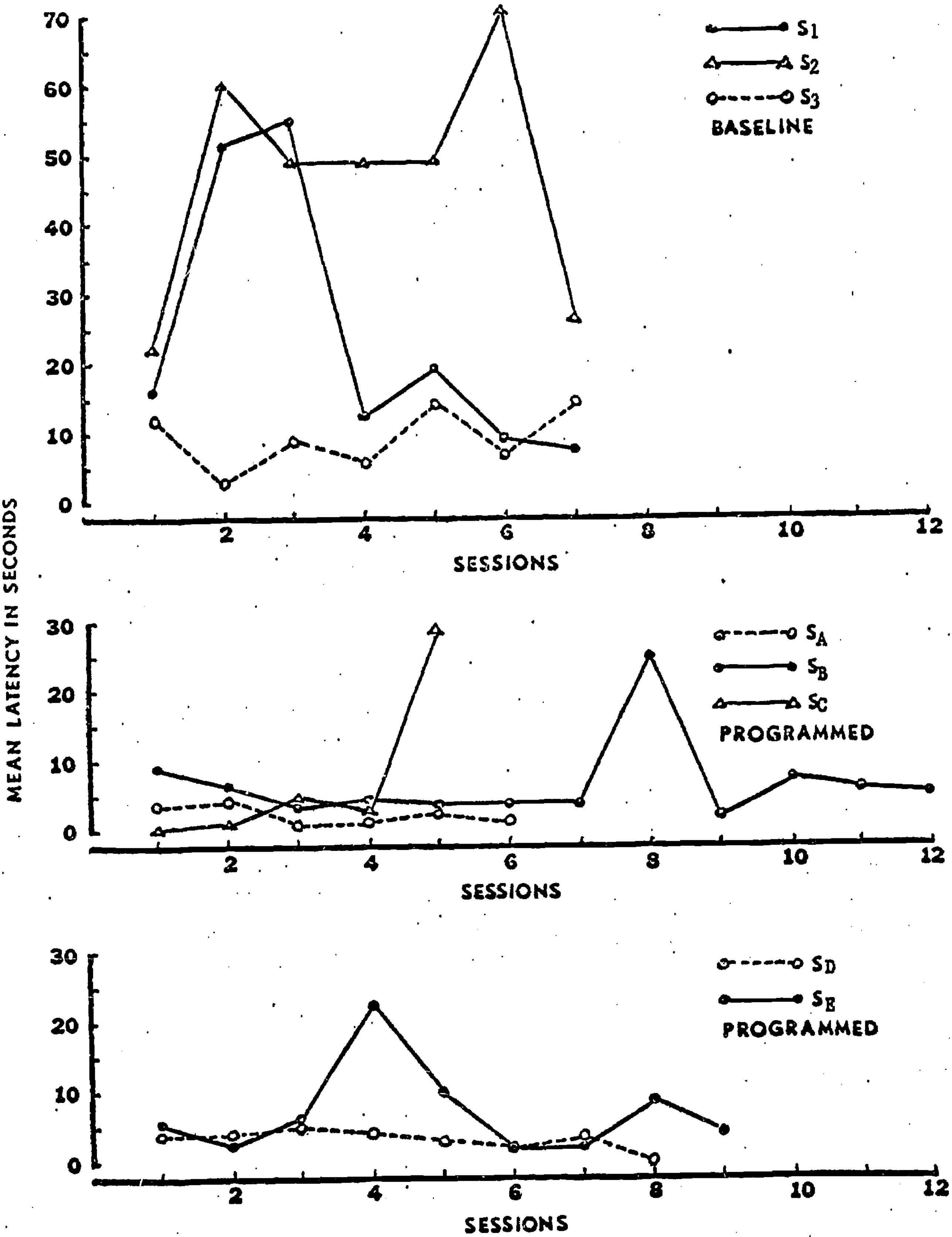


Fig. 11. Mean latency between trials per sessions