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Several 3- to 5-year-old children participated in this study designed to discover the necessary procedures to establish nonresponding in preschool children during delay of reinforcement. The children were divided into two groups: (1) the programed group (PG), to which a 60-second delay period was introduced gradually and (2) the baseline group (BG), to which the 60-second delay was introduced abruptly. They were told to push a button, which sometimes resulted in the child's receiving poker chips which could later be exchanged for a toy. During the test sessions the BG was reinforced on a variable interval (VI) schedule of two to nine seconds. The abrupt delay condition was introduced on the first response after a VI, and no reinforcement occurred for responses until 60 seconds had elapsed. The PG received the gradual 60-second delay condition, in which the duration of the delay was increased in 2-second incre ents. In both groups, supportive stimuli (a tone and a light) were used to indicate the delay period. Results of subject response data indicated that children of this age can learn the discrimination involved, but at least one PG subject did not learn it. The BG subjects did not appear to learn to discriminate between responding during the VI schedule and during the delay condition. (WD)

The University of Kansas Head Start Evaluation and Research Center

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"Errorless Discrimination in Preschool Children: A Program for Establishing a One-Minute Delay of Reinforcement"

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ERRORLESS DISCRIMINATION IN PRESCHOOL CHILDREN:
A PROGRAM FOR ESTABLISHING A ONE-MINUTE DELAY OF REINFORCEMENT[1]

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ABSTRACT

Running head: Errorless Discrimination of Delay of Reinforcement

A program was developed to establish a 60" delay of reinforcement during which Ss were not to respond. Preceding and succeeding each delay condition Ss responded on a VI 5-sec schedule. Two groups of Ss were used; one without programmed delay conditions (baseline subjects); and those under programming procedures. The latter procedures involved: a 2" increase in delay intervals; response light off during delay conditions and faded back on; and a tone signal every second during delay which was also faded in duration and intensity toward the terminal conditions. Results indicate that it is possible to develop the discrimination using the program with Ss making relatively few errors and that such a program is necessary if a fine discrimination is desired. Further revisions in the program are being made to accommodate individual differences among preschool Ss so that the program may be successful with all children.

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ERRORLESS DISCRIMINATION IN PRESCHOOL CHILDREN:

A PROGRAM FOR ESTABLISHING A ONE-MINUTE DELAY OF REINFORCEMENT[1]

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In 1913 Thorndike suggested that learning was adversely affected by delay of reinforcement. Since that time many psychologists have studied the effects of a delay interval between response and reinforcement upon both rate of acquisition and retention. During the 1920's and 30's conflicting results were obtained by those who tested the original Thorndikian position (Watson, 1917; Warden and Haas, 1927; Hamilton, 1929; Wolfe, 1934). The first theoretically integrated position on delay was by Hull (1932) in his goal-gradient hypothesis. He refined his position twice (1943 and 1952) to account for conflicting experimental findings. Spence and associates (1947 and 1956) continued to revise the Hullian theoretical position.

In the 1950's and early 1960's a number of studies using human subjects, based upon or testing the Spence-Hull theoretical position were reported (Lipsitt and Castaneda, 1958; Lipsitt et al., 1959; Erickson and Lipsitt, 1960; Hockman and Lipsitt, 1961; Terrill and Ware, 1961 and 1963; Reiber, 1961 and 1964; Etzel and Wright 1964). All used young children and postulated many variables from "frustration", instructional set, difficulty, competing responses, number of trials, etc., to account for the variety of results obtained. Brackbill and Associates (1962a,b,c, 1963, 1964) reported five studies that showed delay of reinforcement enhanced both acquisition and retention when the subject continued to respond (without reinforcement) during the delay period. Schoelkopf and Orlando (1966) concluded that learning is not necessarily deterred in relationship to the length of the delay, but that trial-spacing conditions and stimulus factors may be closely related to delay gradients.

These studies are only a few of the many carried out in this area. However they do represent the state of the science at the present time. Inconsistency in results have been the rule over the past 50 years.

The majority of these studies were attempting to document delay variables, hypothetical or empirical, that affect acquisition, latency, or retention. Even "personality" variables have been postulated to explain results. Thus, very little can be said about <u>which</u> dependent variables are affected when the time interval between the response and onset of reinforcement is increased.

Instead of asking the traditional question of how delay affects learning, an alternative question could be, what are the procedures which establish no responding during a delay period? By asking similar procedural questions within the past decade psychologists have been able to avoid "blind" theoretical alleys and have produced procedures which work in both "worlds", in and out of the laboratory.

While observing man's behavior in the natural environment, it becomes apparent there are two distinctly different, as well as incompatible, but "desirable" behaviors generated by delay of reinforcement, i.e., responding and not responding during the delay period. First there is the situation in which a person continues responding during long intervals between observable reinforcements, e.g., the salesman who makes many calls for each order received. In this situation the "desired" behavior continues until reinforcement occurs. The second situation is one in which the person makes a response and must subsequently wait for a period of time during which no responses are emitted prior to reinforcement. For example, a child states he is hungry and requests a cookie just prior to dinner. The mother tells the child it is almost time for dinner so he must wait. The child no longer requests food (stops responding for food) and waits for the interval to pass before dinner. However, Chung (1965, 1967) demonstrated that pigeons will respond to produce the schedule of concurrent schedules which has the shorter delay periods.

Renner, (1964) suggested that experience with delay could be an important variable in determining an organism's ability to "function" (respond) during delay of reinforcement, thus referring to the first type of delay situation. He further pointed out that no studies of this nature had been reported. However, it appears that behavior described as steady responding during the delay period corresponds to performance during a variable interval (VI) or variable ratio (VR) reinforcement schedule. Certainly the literature is substantial in this area. The typical performance generated by a VI reinforcement schedule is moderate, steady responding between reinforcement presentations which occur at variable time intervals. For those who describe the ability of an organism to continue responding while delaying "gratification" as being related to a high level of social maturity (Mischel, 1961), there is a clear set of procedures for establishing this type of behavior in the VI reinforcement schedule literature.

Many psychologists are also interested in the second type of delay described above, i.e., the organism responds and then waits during a time interval before reinforcement. That is, he stops emitting the original response though he may be emitting responses of other types. The critical point appears to be discriminating when to emit the critical response and when it should not be emitted. Hence, discriminations beyond those of the time interval are often involved. Some studies in the operant field approximate this condition. For example, multiple VI-Extinction schedules, with the schedules associated with red and green lights respectively, will result in responding under red light conditions and not under green. Procedures other than extinction have also been used to establish no responding under certain conditions. These include punishment, DRO, and DRL.

Terrace, (1963a,b) in his work on discrimination training with pigeons has demonstrated that it is possible to obtain control over responding and not responding without the occurrence of errors, primarily by manipulation of the stimulus not discriminative for reinforcement. This was done by first conditioning a key-pecking response in the presence of a red light. A darkened key was introduced following reinforcement on the red light for a brief interval. The presentation of the darkened key increased in length of time. Finally a light green light replaced the darkened key and ultimately increased to the same duration and intensity as the red light, thus controlling responding and not responding.

Many of the procedures Terrace (1963a, b) used are also part of the technology used in programming. The use of fading those stimuli which control responding in or out for the purpose of having stimuli other than the original controlling stimuli acquire control of responding has been described by Moore and Goldiamond 1964; Bijou 1968; and Sidman 1967. Each of these studies has used fading procedures to decrease the occurrence of errors during the acquisition of a task. Thus without the use of extinction, punishment, DRL or other procedures it is possible to control responding or not responding by stimuli which precede the response.

Ferster (1953) maintained the response rate of pigeons on a VI schedule by gradually introducing the delay period during which the experimental chamber was darkened. However, it may be argued that the free operant aspect of the experiment was lost during the delay period, since pigeons do not ordinarily peck in darkness. In an analysis of this experiment, Ferster argues against the above criticism in that he felt that the adjusting fixed interval period of delay was conducive to the development of superstitious behavior. This superstitious behavior became part of a chain, and reinforcement maintained the entire chain.

Ferster and Hammer (1965) established a 24-hour delay interval into a chain of responses and maintained responding during the delay. Initially they increased the delay periods gradually, but in a subsequent experiment found this was not necessary.

Ayllson and Azrin (1964) have reported the only work done with humans in a free operant setting. They used delay of reinforcement as an effective punishing device when patients failed to pick up their silverware.

The present study was designed to discover the necessary procedures to establish non-responding in preschool children during delay of reinforcement without the occurrence of errors. The procedures were directed toward first establishing a S response to a particular stimulus. Not responding during a time interval between an S^D and reinforcement was then programmed by increasing the delay period in small increments of time and enhancing the extablishment of not responding during the delay period by introducing supportive stimuli. This latter procedure was an attempt to establish no responding during the delay period in an errorless manner. Once a full one-minute delay with no responding was obtained, the supportive stimuli were slowly faded. This resulted in the experimental procedures being devoid of programmed cues and thus the terminal discrimination was made solely on a time basis.

METHOD

Subjects

The Ss were preschool children, ranging in age from 3 to 5, who were attendin the University of Kansas Preschool Laboratories. The study was carried out in a room that was part of the research area, located on the top floor of the preschool building.

Apparatus

A Grason-Stadler push button manipulandum was mounted on an adjustable panel inserted into the rear wall of an experimental booth. The push button was positioned approximately four inches below the eye level of the seated child. An inline digital readout unit and a Gerbrands AC transformer illuminated the push button. The readout unit projected a figure "O" into the center of the push button. The brightness of the bulb lighting the push button was controlled by a 2000 ohm rheostat and a verneer dial which was calibrated in thirty equal dimming steps to control the light from full brightness to off.

A Gerbrands poker chip dispenser mounted behind the panel, outside the booth, delivered poker chips into an enclosed plastic container located beneath the push button manipulandium.

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. They were wired through an alternator which operated an electronic timer and stepper to program the delay period in 2" increments. The alternator was also used to turn off the response light and deliver a single tone of constant volume from an audio-signal generator at the completion of the VI response requirements. The alternator also controlled the delivery of a series of tones during the delay period. The series of tones was produced by running the audio signal through a multi-gang timer which produced a tone-on for 2/3 second and off for 1/3 second. The series of tones was controlled by a volume control of 10,000 ohms and a verneer dial calibrated in thirty equal steps to reduce the volume until it was 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.

White noise from a tape deck was delivered through a second speaker mounted on the wall of the booth to the left and above the subject. This was used to mask sounds produced by the experimental equipment.

A Gerbrands Harvard cumulative recorder was used to record responses during the VI period, mark reinforcements, and record responses made during the delay periods. A second pen was used to record the duration of the VI and the delay periods. Responses during the VI and delay periods were also counted on separate digital counters.

Procedure

There were two groups of Ss for whom the procedures were identical in all respects except the 60" delay period was gradually introduced for one group (Programmed Ss) and abruptly introduced for the other (Baseline Ss). This design represents two extreme conditions on a continuum of varying amounts of programming involved in establishing no responding during a delay interval. In later studies other Ss will receive varying amounts of programming between these two extremes so that samplings are made across the continuum in an effort to evaluate how much programming is necessary, and at what times.

Procedure, Baseline Subjects

The S was brought from the nursery school group to the experimental booth by E. The push button was lighted when the subject entered the booth, and white noise came from the speaker located on the side wall of the booth. The subject was told to sit in the chair facing the response panel, and the helmet with earphones attached was placed on his head. The experimenter demonstrated a button push as she said, "When you push this button, sometimes you get a chip."

After the poker chip fell into the container, the experimenter said, "When you have enough chips you can trade them for one of these toys." The subject was shown a box containing five toys, and asked which one he would like to work for today. When he had indicated a choice, the experimenter told him she would tell him when he had enough chips, and left the booth.

The number of training sessions each S received prior to the onset of delay conditions and the schedule of reinforcement for the individual sessions was determined by the response pattern of the subject. At first all subjects received at least six chips on a FI 1½-sec schedule. If, at this point, their response rate was low with extended pauses between responses, further training on this schedule was given until the response rate increased. When possible the subjects were switched, after the initial six reinforcements on FI 1½-sec, to either a VI 15-sec (range 2" to 27") or to a VI 5-sec (range 2" to 9") schedule. Two or three sessions on VI 5-sec or VI 15-sec in addition to the first FI 1½-sec session were usually necessary for each Baseline Subject, since delay sessions were not begun until the subject achieved a stable response pattern on the VI schedules for two consecutive sessions.

Each reinforced button push during the initial training sessions resulted in three simultaneous consequence events: 1) the response light went off and came back on, 2) a single tone was presented through the earphones and the speaker above the response panel, and 3) a poker chip dropped into the plastic container beneath the response panel.

During delay sessions Baseline Subjects A, B, C, and D received 60, 60" delay periods divided equally over four sessions. Subject E received 43, 60" delay periods in five sessions. The third session for Subject E was terminated when the subject did not respond for seven minutes on the VI schedule following the third delay period of that session.

The delay condition for Baseline Ss was as follows: one interval of VI 5-sec with a subsequent response initiated a 60" delay period after which a poker chip was delivered. S began responding on a VI 5-sec schedule. The first response following each VI interval resulted in the response light flashing off and on while a single tone was presented simultaneous through the earphones and speaker. Following the light flash and the tone, the delay period began. Therefore a delay period followed each segment of the VI 5-sec schedule. After 60" the reinforcer (poker chip) was always delivered and the next interval of the VI 5-sec schedule began, thus repeating the sequence.

To initiate the delay, at least one response, following the VI interval, was necessary. If S responded during the VI schedule, but stopped responding before the interval was completed, the delay condition never began. Responding during the delay was without experimental consequences, although it was considered an error.

The baseline procedure can be thought of as representing a "trial-and-error" approach to the training of not responding during delay. There were no gradual increases in the delay periods nor were there any fading procedures used as will be described under the programmed sequence. The purpose of running the Baseline Ss was to determine if a preschool child could learn under trial and error delay conditions, to respond during VI but not during the 1' delay period. Figure 1, diagram 'B' shows a summary of the sequence of events for the Baseline Subjects which are the same as the <u>terminal</u> conditions for the Programmed Subjects.

Procedure, Programmed Delay Subjects

The programmed delay subjects received the same instructions and demonstration of the push button as was administered to the Baseline Subjects. Because there are slight procedural variations between the Programmed Ss, each will be separately described.

During the first training session for Subject 1, six chips were delivered on a FI 1½-sec schedule, followed by 36 chips on VI 5-sec. The second training session was programmed on a VI 5-sec schedule with 54 chips delivered. The delay programming sequence began in the third session by inserting a 2" delay between the first response-to-be-reinforced on a VI 5-sec schedule and the delivery of the chip. The delay interval was then increased in 2" increments each succeeding delay period. When the response-to-be-reinforced was emitted, the response light darkened and remained dark for the duration of the delay. Simultaneous with the response light going off, a tone sounded through the earphones and speaker which was followed by a series of tones sounded at 1" intervals for the duration of the delay. At the end of the delay period, regardless of the length of the delay, a poker chip was dispensed, the series of tones ceased and the response light was turned on. The delay period was increased from 2" to 40" during the first session, and from 42" to 60" during the second session.

The third, fourth and fifth sessions of programmed delay consisted of 10, 60" delay periods. During these sessions the response light was increased to full intensity in 30 steps. The series of tones was terminated 2" prior to the end of the 60" delay on the first sequence of the third programmed session. It was shortened by 2" for each subsequent delay period. Simultaneous with shortening the duration of the series of tones, the volume of the tones was also decreased in 30 equal steps until inaudible.

In the final condition of the programmed delay the response light was on at full intensity and a VI 5-sec schedule was in effect. When the response-to-be-reinforced was emitted, the response light flashed off and immediately a single tone sounded through the earphones and the speaker, and there was a delay of 60" prior to the delivery of the reinforcement (poker.chip). These were the same conditions as those for the Baseline Ss in all delay sessions.

Insert Figure 1 about here

Subject 2 had a prior history of refusing to participate in experimental work and required training sessions different from those given to the Baseline Subjects or to Subject 1. The Head Teacher of the preschool accompanied S_2 to the experimental booth. S_2 was persuaded to push the button once for a poker chip the first day. The second day the session was terminated when Subject 2 cried after receiving six chips on a VI 5-sec schedule. The third day S_2 sat on the Head Teacher's lap and received a chip for every button push he made. E, observing from the back of the booth, activated the poker chip dispenser with a hand switch. The fourth day S_2 sat in the chair and wore the earphones for the first time. The Head Teacher sat in the rear of the booth. The Experimenter continued to use the hand switch during the initial delay periods of 1" to 10" (in 1" increments) by counting the tones and operating the poker chip dispenser. Beginning with 10" delay he was placed on the automatic equipment and was advanced to 22" delay on this session. The following session was started with a 10" delay and was advanced to 32" in 2" increments. The Head Teacher accompanied him to the booth for this experimental session, and withdrew to the observation booth for the duration of the session. During the next two sessions, the delay periods were increased from 32" to 46" and from 46" to 60". $\underline{S}_2$ was then continued on the same program as $\underline{S}_1$ for three sessions of 10, 60" delay periods each. The response light was increased and the tone decreased in duration and intensity as described under the procedure for Subject 1.

Subject 3 received two days of response training. The first session consisted of 6 chips delivered on a FI 1½-sec schedule, followed by 36 chips on VI 5-sec. The second session was on a VI 5-sec schedule for the delivery of 54 chips. Programmed delay was started on the third session and $\underline{S}_3$ was advanced to 40" delay by 2" increments. During the fourth session delay was 40" to 60". The fifth, sixth and seventh sessions consisted of 10, 60" delay periods each. The response light intensity was increased and the sound decreased in duration and volume in 30 equal steps, as was the procedure of Subjects 1 and 2.

RESULTS

Figure 2 depicts the stablized response pattern of the Baseline Subjects for the last two days of training on VI 5-sec. The responses of Subjects A, B, D and E stablized at criteria on the second and third sessions. Subject C received training on VI 15-sec for the first and second sessions, and on VI 5-sec on the third and fourth. Figure 2 shows his performance during the third and fourth sessions. Subject E emitted 161 responses for 54 reinforcers during his second session and 174 responses for the same number of reinforcers

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Insert Figure 2 About Here

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during session three. Response counts for Subjects A, B, C and D are unavailable because their sessions preceded delivery of the digital counters. The number of reinforcer deliveries for the two training sessions prior to the introduction of non-programmed delay conditions were as follows: Subject A, 66 and 72; Subject B, 108 and 72; Subject C, 72 and 72; Subject D, 76 and 90; Subject E, 54 and 54.

Figure 3 shows the response curve of the Baseline Subjects on the last day of responding under non-programmed delay conditions. The cumulative curves are from 60" delay periods 46 to 60 for Subjects A, B, C and D. For Subject E it shows the curve for the 60" delay periods 34 to 43. Subject E emitted 13 responses during VI and 25 responses during delay for this session. Response totals for the other Baseline Subjects during VI schedule and delay periods are not available. The cumulative curves of all five subjects under non-

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Insert Figure 3 About Here

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programmed delay indicate responding (errors) during the 60" delay periods. For Subject A the record of the last session indicates a tendency to pause prior to reinforcement, but many errors were made during the 60" delay period. Subject B showed no discrimination between VI 5-sec and delay conditions. His rate remained high and steady throughout. Subject C's records also indicated no discrimination formation between the two conditions as there is a low steady rate across both the VI and delay conditions. The response curves of Subjects D and E show longer periods of no responding than the first three $\underline{S}$s. However, in many instances there are bursts of responses during the delay period or at the end of delay (just prior to the reinforcement hatch mark). None of the five Baseline Ss acquired the discrimination between conditions under which to respond and those in which response is not necessary.

Figure 4 shows the two training sessions (prior to delay conditions) for the Programmed Delay Subjects. Subject 1 received 6 reinforcers on FI 1½-sec and 36 reinforcers on VI 5-sec, with total responses at 215 during the first session. The second session produced 54 reinforcers for 433 responses on VI 5-sec.

Twelve reinforcers for 56 responses were delivered to Subject 2 during the first session. The session was terminated when the subject cried, so he was not permitted to trade his poker chips for a toy. The second session on CRF produced 32 reinforcers which, along with the poker chips he had accumulated the day before, were exchanged for a toy.

Insert Figure 4 About Here

Figure 5 depicts the cumulative response curves for the Programmed Delay Subjects during the delay periods. In session 1 Subject 1 advanced from 2" to 40" delay periods. During the VI schedule 114 responses were emitted with 11 responses (errors) occurring during delay. Session 2 began with a 42" delay and increased in 2" increments on each subsequent trial to 60" delay. There were 62 responses emitted during VI with only one response emitted during the delay periods at the 52" delay point. For each of the next three sessions 10, 60" delay periods were programmed with the response light increasing to full intensity and the series of tones decreasing in duration and loudness. Under these conditions in Session 3, Subject 1 made 40 responses during VI 5-sec and 9 responses (errors) during delay. In the fourth session S_1 had 42 VI responses, 6 responses during delay. Thirty-two VI responses and 2 delay (error) responses occurred during Session 5.

The cumulative curves for Subject 1 indicates a discrimination was established between the conditions of VI 5-sec and delay. There is a sharp but short increase in response rate following the reinforcement hatch mark during the VI 5-sec condition. Responding stops during delay except for a few isolated responses (errors). Of the 29 errors that Subject 1 totaled for all five sessions only a small number of these were errors (responses) that occurred within the delay period after S had stopped responding on the VI 5-sec condition. The rest of the errors could be called "spill over" errors which are continued responses after the VI 5-sec condition stops and delay starts.

Subject 2 was hand shaped during his first session to a 10" delay in 1" increments on successive trials. He was then switched to the automatic program which increased the delay in 2" increments to a 22" delay period. S_2 emitted 83 responses during CRF and VI 5-sec and 1 response during delay. The second session was started with a 10" delay period which increased to 32" during that session. He emitted 36 responses during VI and 3 responses during delay. Within sessions 3 and 4 S_2 was advanced from 32" to 46", and from 46" to 60" delay periods, respectively. There were 20 VI responses and 0 delay responses during Session 3. There were 17 responses during VI and 0 responses during delay during session 4.

In each of sessions 5, 6 and 7 there were 10, 60" delay periods, with the response light increasing to full intensity and the series of tones decreasing in duration and loudness in 30 equal steps.

The total responses during VI 5-sec and responses (errors) during delay for Session 5 are 31 and 2 respectively. During Session 6 the VI responses totaled 27 and delay responses (errors), 10. Session 7 resulted in 29 responses during VI and 2 delay errors. Subject 2 therefore made 22 responses (errors) during a total of 49 minutes and 15" delay conditions.

Insert Figure 5 About Here

Figure 6 shows the cumulative response curves for the seven sessions for Subject 3. Responses totaled 170 for 54 reinforcers delivered during the first session on FI 1½-sec and VI 5-sec with 274 responses for 54 reinforcers on a VI 5-sec during Session 2. During Session 3, the first day of programmed delay, when the delay period was increased 2" each trial, $\underline{S}_3$ responded 73 times during VI and emitted 151 responses during delay. Session 4 began with a 40" delay, advancing to a 60" delay in eleven steps. There were 41 responses during VI and 118 during delay. In the last three sessions there were 10, 60" delay periods each, with the response increasing to full intensity and the series of tones decreasing in duration and loudness.

These last three sessions, five, six, and seven, were approximately the same length and Subject 3 made 16, 21 and 21 responses respectively to the VI condition. However this S's responses during the delay period increased across the last sessions from 89 on the third session, to 105 on the fourth to 168 on the fifth. Subject 3 was continued on the program even though it was apparent she was not making the discrimination and her errors (responses) during delay were very high.

Insert Figure 6 About Here

DISCUSSION

A delay of 60" between a response and the delivery of the reinforcement had no similar systematic effect among the response rates of five Baseline Subjects when compared on VI 5-sec without delay conditions. The cumulative curve was much higher with delay for one subject than it was on VI 5-sec; for two subjects the cumulative curve was depressed, and for the other two it stayed appreciably the same. This is not entirely consistent with the free operant animal literature which tends to show that the onset of delay decreases response rate (Dews, 1960; Azzi, et al., 1964).

The Baseline Subjects, when introduced to non-programmed delay, did not make a discrimination between responding during VI 5-sec and not responding during delay. Two of the three Programmed Subjects were able to approximate an errorless discrimination between conditions for functional responding and those which were not. Gradually increased delay periods and fading procedures of both light and tone (duration and intensity) appear to be fairly successful for the first two Programmed Delay Subjects.

The responses of Subject 3, however, did not appear to be controlled by the programmed stimuli. It would be difficult to argue that $\underline{S}_3$ was not under reinforcer control since the overall response rate was fairly high. $\underline{S}_3$ was continued on the program, in spite of errors, so that response curves could be compared at the end of the program with those of the Baseline Ss. $\underline{S}_3$'s last program day of responding (Figure 6) is much higher in rate during delay than Subject E's (Figure 3) last (non-programmed) delay day. This comparison indicates that for some children the program in its present state is not effective for establishing the discrimination. On the other hand, it would also appear that without introducing the program the fine temporal discrimination which is desired probably would either not be made or would be made only subsequent to many errors.

This study is still in progress due to the late arrival of equipment. It will continue for another six months. At present both the equipment and the program are being slightly revised to handle those problems such as Subject 3 presented. One procedure that will be tried is suggested in Terrace's (1963a,b) work with pigeons. He found that introducing a stimulus which was discriminative for not responding (S^{Δ}) for a brief period after the first exposure to the discriminative stimulus (S^D) and gradually increasing the exposure time of S^{Δ} produced fewer or no errors during discrimination acquisition. It is possible that prior training on a VI schedule will have to be eliminated in favor of presenting the delay immediately following conditioning of the button press response during VI conditions, or some other procedures which will eliminate errors across more Ss. VI conditions can be reintroduced.

Other studies (Hammer and Ferster, 1965) suggest that the lengthy fading programmed in this study may be shortened by using larger steps at some point after a very gradual beginning. Where this point is and whether it is the same for all subjects are empirical questions which we plan to investigate.

FOOTNOTES

[1]The research reported herein was performed pursuant to a contract with the Office of Economic Opportunity, Executive Office of the President, Washington, D.C. 20506. The opinions expressed herein are those of the authors and should not be construed as repesenting the opinions or policy of any agency of the United States Government.

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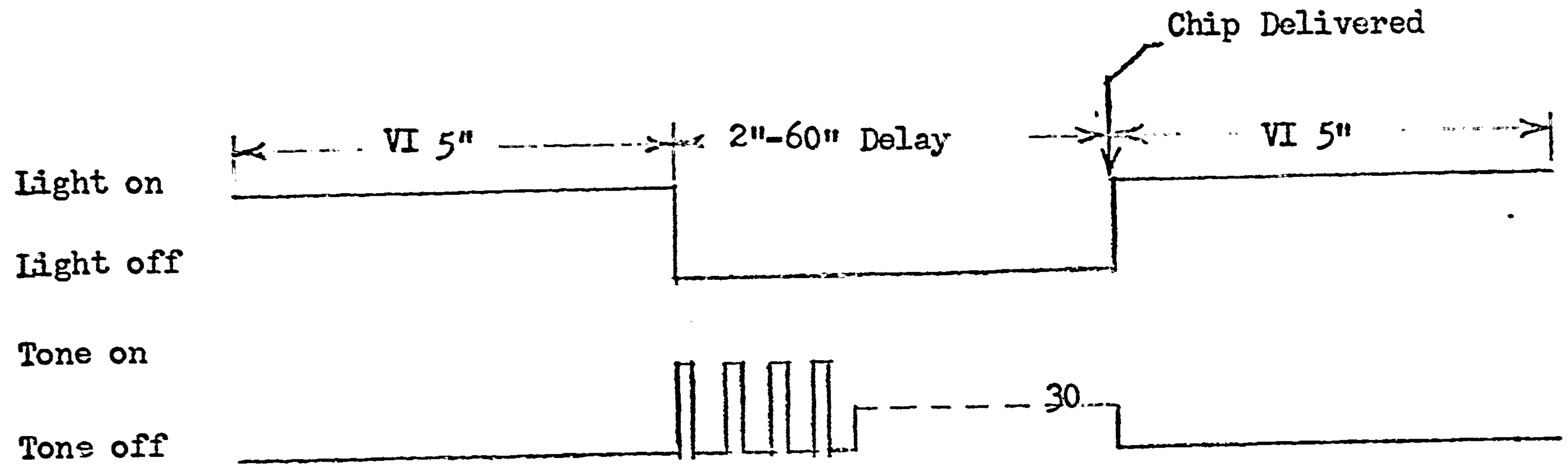
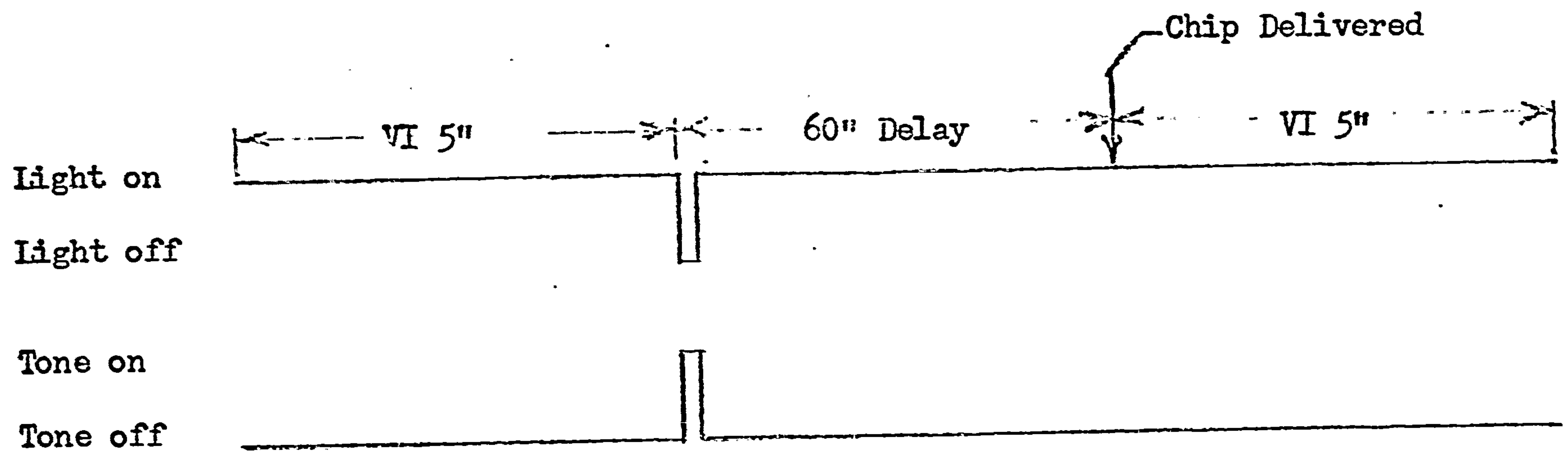


A: Tone and light conditions first phase of programmed procedure



B: Terminal tone and light condition of programmed procedure and only condition for baseline subjects.

Fig. 1. Tone and light conditions during first phase and terminal trial of programmed procedure and (B) conditions for baseline subjects.

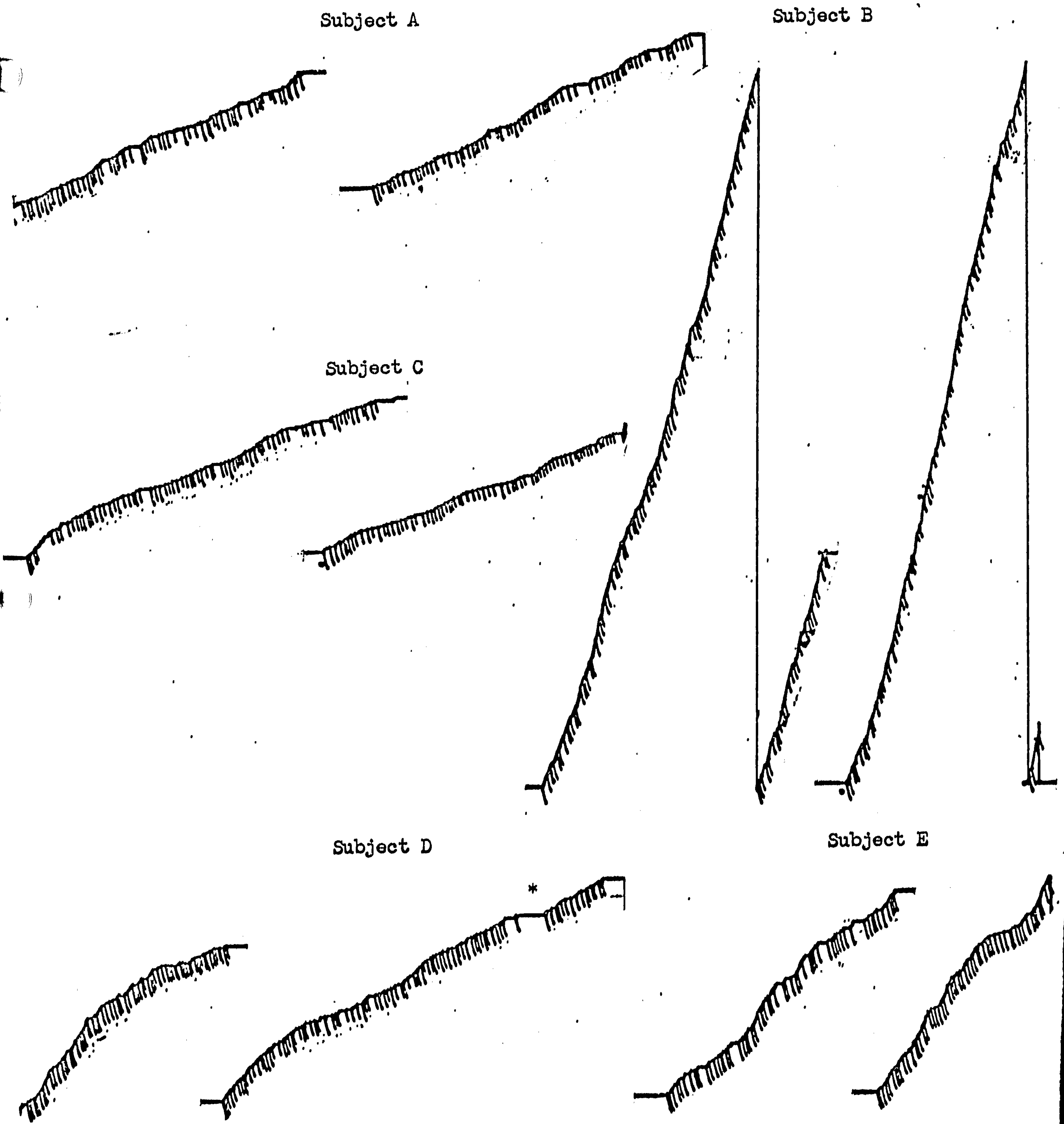


Fig. 2. Baseline subjects. Examples of 2 days of stable responding under VI 5-sec prior to delay.

* Subject took helmet off.

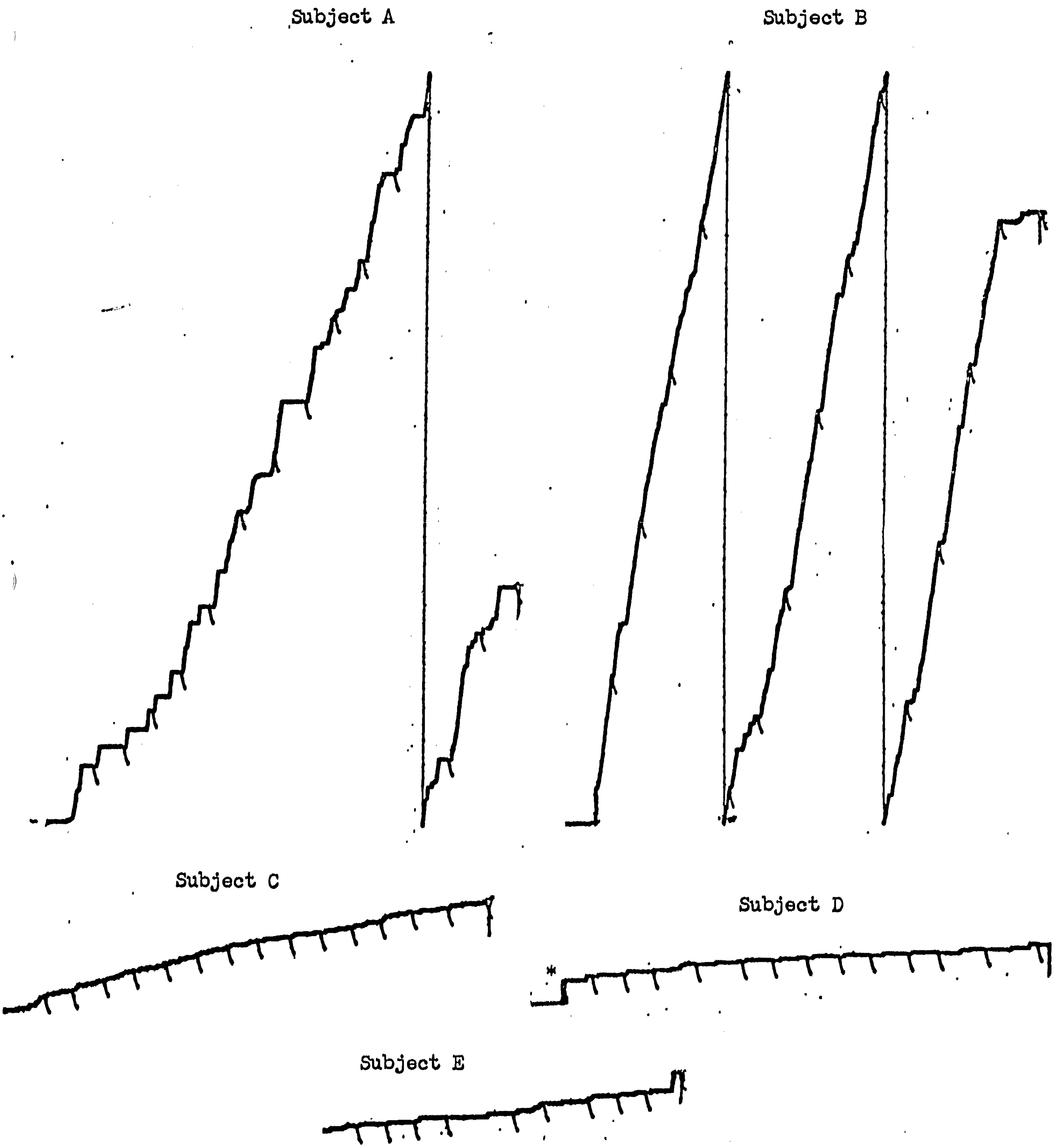


Fig. 3. Baseline subjects. Examples of last day of responding under non-programmed delay conditions.

*Cumulative recorder motor off for first 2 delay periods.

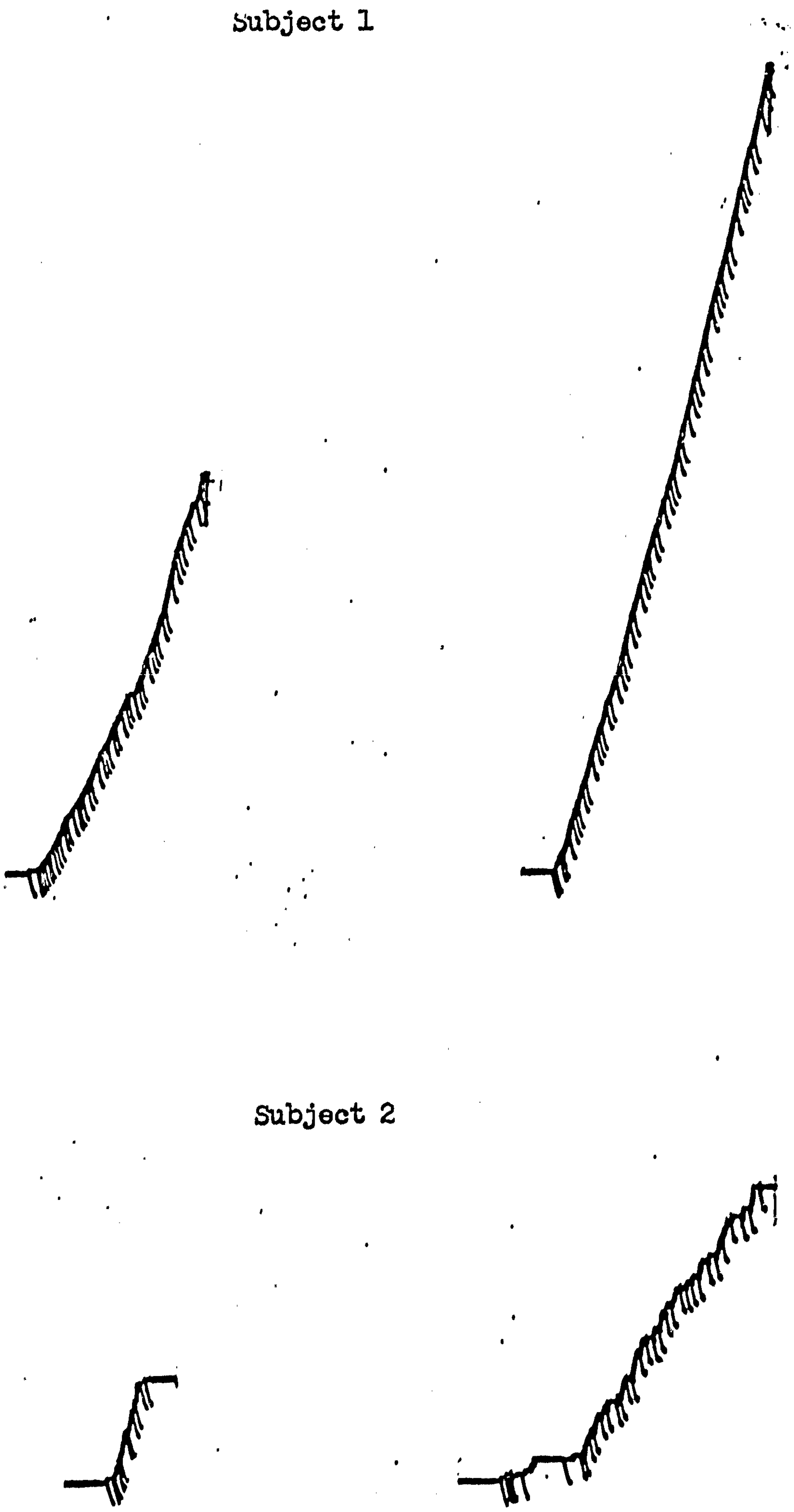
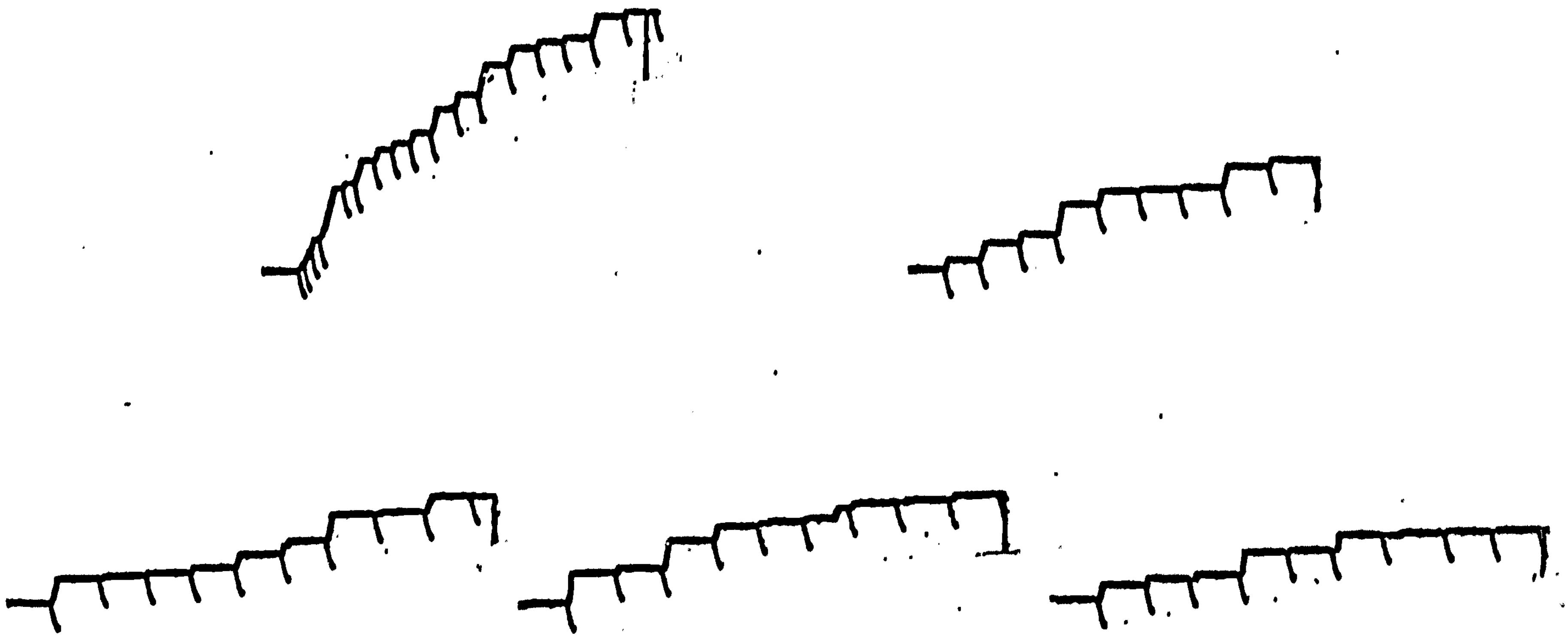


Fig. 4. Programmed subjects. Examples of 2 days of stable responding under VI 5-sec prior to delay.

Subject 1.

Sessions 1 and 2 take subject up to the 60-sec delay with light off and tone on during delay. Sessions 3,4, and 5 continue on 60-sec delay with light fading on and tone fading out.



Subject 2.

Session 1 was hand shaped for delay increments of 1-sec to 10-sec. Subject then placed on automatic equipment and increased to 20-sec by 2-sec intervals. Session 2,3, and 4 took subject to 60-sec delay with light off and tone on. Sessions 5,6, and 7 continued subject on 60-sec delay with light fading on and tone fading out.

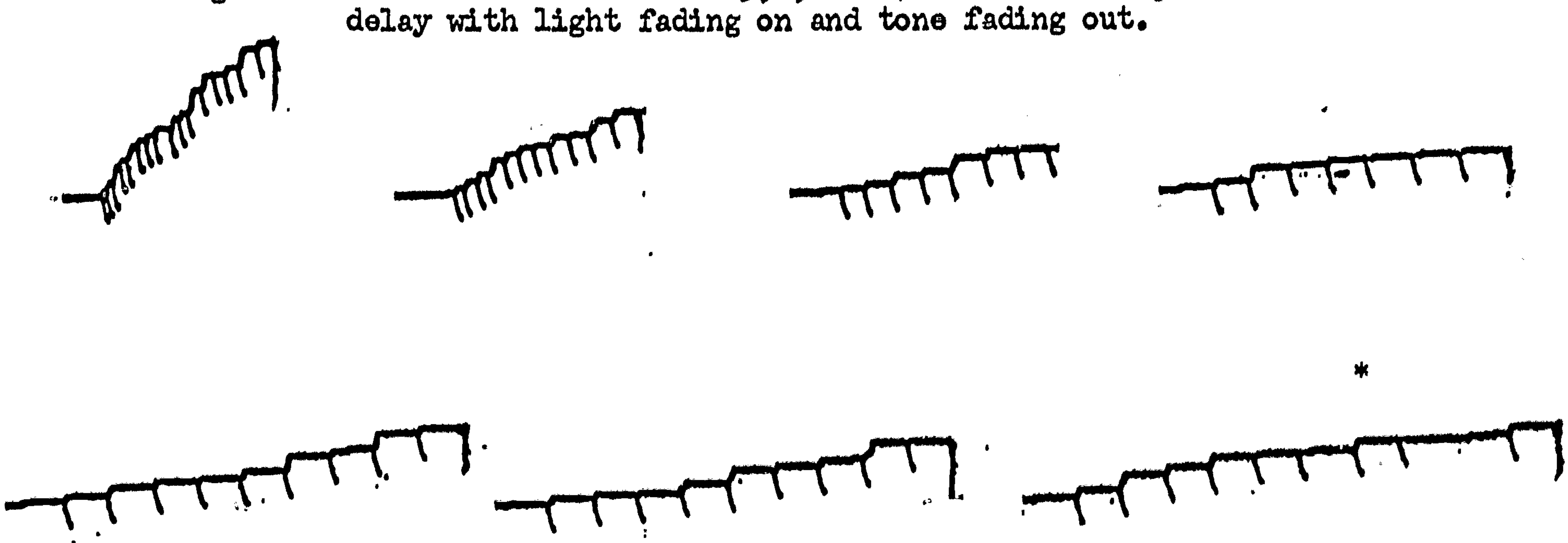


Fig. 5. Programmed subjects. Cumulative response curved during programmed delay periods.

* Subject went to bathroom.

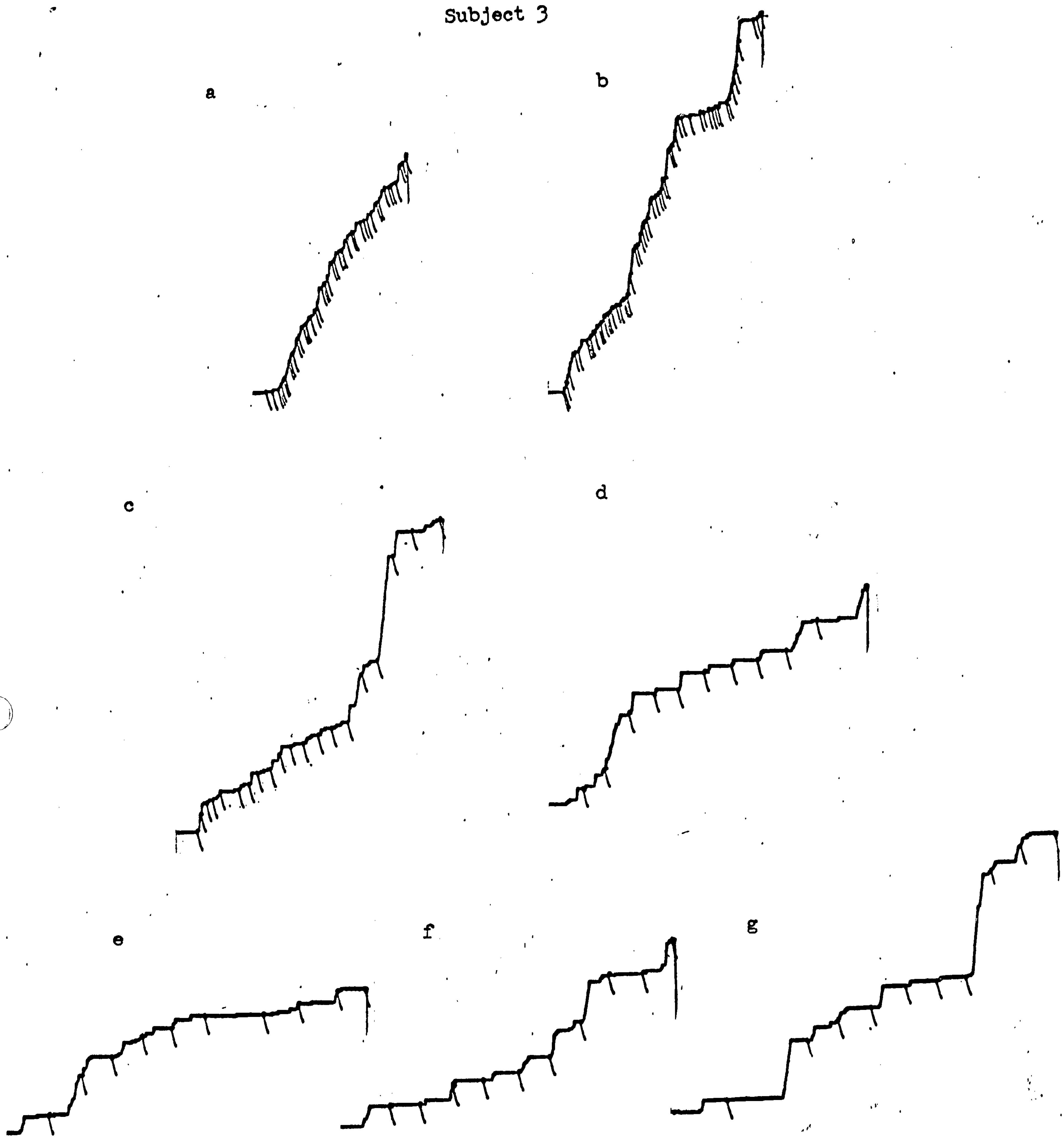


Fig. 6. Programmed subject. Cumulative response curves: a, b - VI 5-sec training; c, d, e, f, g - programmed delay periods for 5 consecutive sessions.