Fixed-ratio reinforcement in verbal conditioning¹

LAURENCE P. INCE,² *Florida State University, Tallahassee, Fla. 32306*

Fixed-ratio reinforcement was employed with college students to modify the rate of emission of positive self-reference statements. Ss were seen daily in a study employing a longitudinal research design, and changes in the critical response class were measured over time. Following a baseline period, Ss were placed on an arithmetically increasing fixed-ratio schedule of reinforcement. When a stable state of responding was reached at the final condition of the schedule, responding was extinguished and then reinstated by once again reinforcing the desired response. Results indicate that the reinforcement procedures markedly increased the number of positive self-reference statements without affecting overall verbal output.

One type of verbal conditioning study that has been receiving increasing attention is one involving a complex response to a relatively nonrestricted stimulus situation. Grossman (1962) reinforced verbal expressions of feeling in a psychotherapy setting. Rogers (1960) conditioned positive and negative self-reference statements in a situation resembling a clinical interview. Ince (1968a, b) used scheduled reinforcement to condition similar statements in simulated counseling and therapy settings. While most verbal conditioning research has employed a statistical or factorial experimental design, it appears that the use of a longitudinal design, in which individual behavior over time is measured, should be investigated further. The present study is an attempt to do this.

SUBJECTS

Two undergraduate female students at Florida State University acted as Ss. Their participation was voluntary, and they were paid at the rate of \$.25 per session, received in total upon completion of the experiment.

APPARATUS

The experimental room contained a desk and two chairs. Ss sat across the desk from E. A microswitch (80511-CE, Electrical Specialties) was mounted on a wooden board, 8½ x 11 in., and located under the desk, being operated by foot by E. Connected to this was a counter (99 g 9511, Lafayette) that counted the Ss' responses, each foot tap by E silently registering one digit on the counter. The

counter was enclosed in a thick, fiberglass-lined, plywood box, located on the floor beside E. Also connected to the microswitch was an electrical stepping relay (M.E.R.-115AC, Guardian). This was, in turn, wired to a terminal mounting. Both units were fastened to an aluminum chassis for stability, and the chassis was enclosed in a fiberglass-lined, sound-inhibiting steel box placed on a 2-in.-thick foam rubber pad to reduce noise further. The stepping relay was wired to a small red bulb, located several feet above and behind S, in a recessed corner of the ceiling of the experimental room. The relay was itself so wired that a desired number of foot taps by E turned on the bulb for a fraction of a second. This acted as a signal to E that the prescribed number of responses on the reinforcement schedule had been reached, and that reinforcement was to be delivered. In fact, one digit less than the prescribed number was wired so that E could reinforce immediately upon emission of the next critical response.

A tape recorder was on the desk in the experimental room. This lent authenticity to the situation (as described to the Ss) and acted as a check on E's judgment of the critical response class.

All apparatus, with the exception of the tape recorder, was out of sight and hearing of the Ss. This was verified by their statements, upon termination of the study, that they were unaware of any visual or auditory stimuli other than E's voice and the recorder during the experiment.

PROCEDURE

Each S was seen individually for 30 min per day, 6 days per week. Ss were told that they were taking part in a study that was attempting to determine how students' views change daily as a function of being in an academic setting. When S entered the room, she was told to be seated and to speak as she wished concerning her attitudes, ideas, feelings, etc. No other restrictions were placed on her behavior.

The response class under investigation was designated as positive self-reference statements. These were operationally defined as beginning with the pronoun "I," containing no expression of doubt and no expression of negation. The precise definition has been previously reported (Ince, 1968a). Reinforcement consisted of E's paraphrasing S's responses or, when the time interval between statements was too brief to permit a reinforcer of this length, saying "mmhmm" or "good." The former

has been demonstrated as reinforcing by Dinoff, Rickard, Salzberg, & Sipprelle (1961) and by Waskow (1962), and the latter have been successfully employed by Greenspoon (1955), Mandler & Kaplan (1956), Cohen, Kalish, Thurston, & Cohen (1954), Sarason (1958), and Hildum & Brown (1956).

For each S, an initial base rate of responding was obtained. During this time, no reinforcement was given for any of S's verbalizations. This period continued until a stable operant level of responding was reached. Stability was judged to have occurred when S had gone for three consecutive sessions without a change of 5%, or greater, in number of responses emitted per session. For each run of three consecutive sessions, the mean number of responses emitted during the first and second sessions was compared with the mean number emitted during the first and third and during the second and third sessions of the run. When these comparisons did not yield a mean difference of equal to, or greater than, 5% for three consecutive sessions, responding was considered to have stabilized. The criteria appear to have been adequate, since they were able to be replicated throughout the experiment whenever a judgment of a steady state of responding was required (see Sidman, 1960).

Following baseline measurement, S was shaped by successive approximations to the point where reinforcement scheduling could be put into operation. Thus, at first, all statements beginning with "I" were continuously reinforced. When S conditioned, statements beginning with "I" and containing no negation were given reinforcement. Finally, only the critical response class received reinforcement. When a stable level of responding for continuous reinforcement (CRF) was reached, the Ss were placed on an arithmetically increasing fixed ratio schedule of reinforcement. When stable responding occurred at the first condition of the schedule, the schedule was shifted upwards to the next condition, and so on, until all conditions were met. The program for the schedule was FR 3, FR 5, FR 7, and FR 9. The criteria employed for stability at each schedule condition were those used in judging baseline stability.

When behavior had stabilized at FR 9, S was placed on extinction, during which no reinforcement was given for any statements. The criteria for extinction were four consecutive sessions equal to, or closely approximating, initial baseline rate, without a 5% or greater change in number of responses emitted per session. A session was considered to approximate baseline if the difference between the number of

Fig. 1. Total number of responses per experimental session for S 1.

responses emitted during that session and any session of the operant period did not exceed 10.

Following extinction, the critical response was reinstated by placing each S back on the reinforcement schedule for one session at each condition of the schedule.

RESULTS AND DISCUSSION

Figure 1 illustrates the number of responses made by S 1 during the experiment for each 30-min session, each data point representing the number of responses emitted during one session. A baseline was established in five sessions, and following this period there was an immediate increase in responding upon the introduction of reinforcement. This is probably an artifact of the new stimulus situation. That is, for the sessions just preceding reinforcement, E remained fairly silent, i.e., only responding to questions such as "Am I doing alright?" and "Should I continue?" by replying in the affirmative. Following this phase, E began speaking more often, i.e., reinforcing critical statements. Thus, the mere fact of E's speaking resulted in a rapid increase of S's overall speech rate, and hence, an increase in positive self-reference statements. As E continued to respond to S's verbalizations, and only to those which met the criteria for the response class under study, his mere speech alone was not sufficient to maintain the high initial rate and so responding declined, being dependent from that point

upon E's specific reinforcements. Thus, overall rate of verbalization was no longer being affected, while the number of critical responses continued to increase.

The symbol "A" on the abscissa of the figure refers to the sessions for which S was reinforced for statements beginning with "I." "B" represents reinforcement for statements beginning with "I" and containing no negation. "C" refers to continuous reinforcement of the complete response class. "R" refers to the reinstatement period. S 1 adapted rapidly to the schedule, each new condition resulting in marked increases in responding within a few sessions. Extinction was rapid, the S meeting extinction criteria within the minimum possible time, indicating the dependence of responding upon reinforcement.

The response was reinstated after it had been extinguished. For CRF and FR 9 conditions, responding was actually higher than during the initial conditioning period, probably as a function of having begun from a higher baseline. Differences are slight, but the data do imply that the reinforcement was effective in controlling behavior.

The symbols on the abscissa of Fig. 2 are the same as those for Fig. 1. Fig. 2 indicates that although S 2 did condition, this S required a great deal more time than did S 1 and did not finally stabilize at as high a rate of responding. Examination of the figure reveals that, with the exception of a few sessions, conditioning was achieved through FR 5. The features of S 2's performance are sufficiently regular to demonstrate the effectiveness of the conditioning process. From this point on, however, responding declined and rose with irregularity, necessitating continual downward and upward shifts of the reinforcement schedule. Finally, when on FR 9, S continued for six consecutive sessions without a significant change in responding, extinction was initiated, and she extinguished rapidly. The response was reinstated following extinction, but not to the number with which it occurred during the original conditioning. In addition, not all schedule shifts were accompanied by increased responding.

It must be pointed out that, while there was an increase in the number of critical responses emitted, there was no marked change in overall speech rate of either S. Measures of the number of words emitted per minute were taken during the first three sessions required for baseline stability and during the last three sessions on FR 9 for both Ss. S 1 emitted a mean of 179.9 words per minute during the baseline

Fig. 2. Total number of responses per experimental session for S 2.

period and a mean of 188.0 per minute during the FR 9 sessions. S 2 emitted a mean of 149.6 words per minute during her baseline period and a mean of 156.6 during the FR 9 condition. Thus, it was the critical response that was being markedly affected by the reinforcement, and not overall speech rate.

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NOTES

1. This study is based upon a dissertation submitted to the Graduate School of Florida State University in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

2. Now at New York University Medical Center, Goldwater Memorial Hospital.

Free recall and organization as functions of paced or unpaced responding and presentation rate¹

S. I. SHAPIRO and IRENE PONCE, *The University of Hawaii*, 2430 Campus Rd., Honolulu, Hawaii 96822

Free recall and intertrial organization of unrelated words were assessed at presentation rates of 1/2, 1, 2, or 4 sec, with recall either paced at 2-sec intervals or unpaced. Total recall times were equated for the two response modes. Neither recall nor organization differed for paced vs unpaced responding. Recall and organization were higher at slower presentation rates, and the two performance measures were positively correlated.

Ekstrand & Underwood (1963) reported a small, but significant, superiority in free recall with unpaced, relative to paced, responding. As the authors noted, however, the amount of total recall time allotted to unpaced Ss (60 sec) was greater than the total time allowed for paced Ss (24 sec).

The present study was designed to determine if recall performance, and also intertrial organization, differ as a function of paced vs unpaced responding when total recall times are equated for the two types of responding. Relatively little attention has focused upon the relationship between presentation time and organization. Cofer, Bruce, & Reicher (1966) found that category clustering (E-established organization) increased with slower presentation rates for a list of categorized words. The present study was, therefore, also directed to assessing the influence of presentation time upon the amount of S-generated intertrial organization for a list of unrelated words.

MATERIALS

A 16-item list was composed of the 15 words of Deese's (1959) List No. 9 and one additional word (note). Out of a possible 240 forward and backward interitem associations within the list, there were only two idiosyncratic associations and one of

8% in a set of normative free-association data consulted.² The Thorndike-Lorge (1944, G count) word frequencies of 10 of the words were AA or A, and the frequencies of the remaining words ranged from 2 to 49 occurrences per million words.

PROCEDURE

Twelve trials were given on a memory drum, each trial consisting of a different random order, with the restriction that no word appear twice in the same serial position and that no word be preceded or followed by another word more than once. A 2 by 4 factorial design was used with two testing methods (paced or unpaced) and four levels of presentation rate (1/2, 1, 2, or 4 sec). The Ss of all groups were given free-recall instructions that stressed that only the number of words recalled was important and not the order of their recall. The four groups of paced Ss were told additionally that they would hear a series of tape-recorded signals immediately after each presentation period and to write down a recalled word each time they heard a signal. If unable to recall a word for a given signal, the paced Ss were told to wait for the next signal and then to try again. The paced Ss were admonished to respond only upon hearing a signal and E monitored their compliance with this task. The pacing was at the rate of 2 sec per word for a total recall period of 32 sec. The pacing signals were recorded on magnetic tape from an audio signal generator at 2-sec intervals and consisted of a 925-Hz tone of 1/10 sec duration. The four groups of unpaced Ss were given a 32-sec recall period for each trial, which was found to be sufficient time for Ss to complete responding. Each S was given 12 lined response sheets that were kept face down until a recall period began when one sheet was turned over to record responses. At the conclusion of each recall period, the response sheet just used was placed out of sight, and a new trial began immediately.

SUBJECTS

The Ss were 200 native English-speaking volunteers from introductory psychology classes at The University of Hawaii. The data of an additional 9 Ss were eliminated for apparatus failures or procedural errors. The experimental conditions were randomized in blocks of eight, with 25 Ss assigned per condition. Approximately half of the 25 Ss in each group were of each sex. The Ss were tested individually or in pairs. No S had participated in a prior free-recall experiment.

RESULTS AND DISCUSSION

Table 1 presents the mean performance per trial for each group in terms of recall, intertrial organization, intrusions, and