SHAPING OF THREE-MAN TEAMS ON A MULTIPLE DRL-DRH SCHEDULE USING COLLECTIVE REINFORCEMENT¹

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Five three-man teams were conditioned to a multiple DRL-DRH schedule during five daily sessions of 3 hr each. The teams were conditioned on the basis of their cumulative response rate regardless of the contributions of individual members. Two individually conditioned Ss were run under a similar schedule for comparison. Although all teams demonstrated some differentiation of response rate under the two legs of the schedule, this difference was not achieved as rapidly, nor was it as stable, as the differentiation in rates achieved in individually conditioned Ss. Team members displayed a variety of response rates as a result of collective team conditioning. Often, individual response rates interfered with obtainment of team reinforcement. The individual team members displayed little S^D control in comparison with the individually conditioned Ss. In general the results suggest that collective reinforcement is highly inefficient in comparison with procedures employing individual feedback.

Principles of reinforcement have been applied for use with groups (Azrin and Lindsley 1956, and Glaser and Klaus 1962). In these studies the interaction between members of the group was reinforced. A group may also be reinforced as a unit on the basis of interaction between group members. The reinforcement of groups in this manner is referred to as "collective reinforcement" Wolff, Burnstein and Cannon (1964).

Conditions which define collective reinforcement are: (1) the group is reinforced on the basis of the cumulative response rate of all members rather than on the basis of the responses of any individual members; (2) the reinforcement is issued simultaneously to all members whether they are responding or not; and (3) each member receives the same number of reinforcements.

These or similar conditions exist in many social situations where feedback is presented to a group collectively rather than to the in-

dividuals in it. Yet, little empirical evidence exists to compare team or collective conditioning to the conditioning of individual Ss.

Wolff *et al.* (1964), found that collective group response rate conditioning could be regulated through collective reinforcement on either a DRL or a DRH schedule. The purpose of the present study was to shape the cumulative response rate of a group on a multiple schedule through the use of collective reinforcement and to compare collective shaping to the shaping of individual Ss on similar schedules.

METHOD

Subjects

Seventeen enlisted U. S. Army personnel, Fort Knox, Kentucky were selected. Two Ss were run individually. The remaining 15 made up five teams of three men each.

Apparatus

Each S was placed in an isolated, sound-deadened room which contained a chair, a table, and a modified Lindsley operant conditioning panel. Briefly, the apparatus consisted of a panel containing three stimulus lights and a response switch. Two of the stimulus lights indicated which phase of the multiple schedule was in operation. Under a continuous yellow light, Ss were reinforced for DRL responses; under a continuous blue light DRH responses

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were reinforced. Responses were recorded on four Gerbrand's Cumulative Record recorders, one for each of the three Ss and one for the cumulative team response. Programming and recording equipment was placed in another sound-deadened room.

Reinforcement

Previous work (Wolff *et al.*, 1964) indicated that playing a radio served as an adequate reinforcer for men working in isolation. For this study, a wide selection of music was taped and served as the reinforcement. This was to prevent possible aversive *ad lib* radio programming. The reinforcement was programmed on a variable ratio schedule. A white light had to be obtained an average of five times to earn the music. The flashing white light would appear when the team cumulated the appropriate DRL or DRH responses. The team had to obtain another white light within 45 sec of the previous one to keep the music on. Thus, it was possible for the team to keep the music going continuously. Failure to obtain a flashing white light within 45 sec extinguished the music, and the group once again had to satisfy the requirements of the VR 5 schedule to turn it on again.

Procedure

To reduce the possibility of communication between members of the teams, each S was supplied by a different Army company. Each S reported to a different area in the experimental building, received his instructions separately, and was placed in a separate room. When each experimental session was over, Ss were individually escorted from the experimental rooms. Each waited in a different area and was sent back to his organization at a different time. When the Ss were questioned at the end of the experiment as to whether they thought they were working in a team, each S reported that he did not know he had been working in a team.

Subjects were not told the significance of the yellow or blue lights. They were told that the white light indicated that they were responding correctly.

Initial team conditioning began on the DRH leg of the multiple schedule. Each team was shifted to the DRL leg after the cumulated response rate had become stable at a high rate and the team could attain the DRH

reinforcement regularly. Shifting between the legs of the multiple schedule was based on team output and stability of performance as defined by the experimenters. Shifting was continued until multiple stimulus control was indicated—*i.e.*, a low rate of response during the yellow light and a high rate of response under the blue light. At this point the experimenters attempted to shape increased response differentiation under the two legs of the multiple schedule by raising the response rate requirement under the DRH leg and lowering the response rate requirement under the DRL leg.

The teams were run for five consecutive daily periods of 3 hr each.

RESULTS

Control Subjects

Figure 1 shows the development of a multiple DRL-DRH schedule for two individually conditioned Ss, T and S. A drop in the baseline indicates that the music had come on. The numbers below the baseline indicate a DRL or a DRH schedule. A designation such as 3" or 5" indicates that Ss were on a DRL schedule requiring an IRT of 3 sec or 5 sec. A designation such as 6/2 or 8/2 indicates that Ss were on a DRH schedule requiring six or eight responses in a 2-sec period. The "pip" marks on the cumulative response record indicate when the momentary white light was presented. The scale at the bottom right of the figure is a reference for gauging the rate of response.

Subject T (Fig. 1) was initially on a DRL-5" and a DRL-3" schedule. Since his initial response rate was too high to receive reinforcement on the DRL schedule, he was shifted to the DRH 6/2 schedule and was able to receive reinforcement. He reached a rate of eight responses in 2 sec under the blue DRH light (a rate of 4 responses per sec). After a period of 45 min, the S was shifted to a DRL-3" schedule (yellow light). After a period of 20 min his response rate began to decline and he was able to obtain the momentary white light regularly. By the end of Day 1, Subject T was already under S^D control. He reached response rates of 4 to 4.5 responses per sec under the blue light (DRH) and a rate of 5 sec IRT under the yellow light (DRL). Shifts to DRH 9/2, DRL-5", and back to DRH-9/2 were obtained

DAY 1

SUBJECT T

SUBJECT S

DAY 2

SUBJECT T

SUBJECT S

Fig. 1. Response rates for individually conditioned Subjects T and S.

the instant the blue or yellow light was changed.

On Day 2, Subject T again shifted from DRL to DRH rates when the stimulus light changed. During the remainder of the day Subject T was not only shifted from DRL to DRH schedules but was differentially shaped so that a rate as high as 11 responses in 2 sec occurred under the blue light, and as low as IRT 20 sec occurred under the yellow light. During the latter part of the day Subject T was placed on DRH-12/2. He showed a record characteristic of fixed ratio schedules in that he paused frequently after obtaining the momentary white light reinforcement.

Subject S (Fig. 1) also was under stimulus control by the end of Day 1. He was started under a DRH schedule requiring six responses in 2 sec, but his rate was too low to receive reinforcement on this schedule. After about

45 min he was shifted to DRL-3" (yellow light) and obtained the white light under this schedule. When Subject S was shifted back to DRH-6/2 (blue light) he continued to respond at a low rate. The DRH requirements were reduced to 4/2. Subject S obtained the white light on this schedule and his rate of response increased markedly. A rate of 8/2 was obtained after 30 min.

During the latter part of Day 1, Subject S was shifted consecutively from the DRH-8/2 schedule to: DRL-5", DRH-8/2, DRH-9/2, DRL-5", DRH-9/2, and DRL-5". In each case his rate of response immediately changed with the shift in S^D .

On Day 2, Subject S shifted from DRL to DRH rates without any warm-up as soon as the S^D was shifted. During the day the experimenter was able to shape the S so that his rate differentiated from DRH-13/2 to DRL-

20". Again the fixed-ratio-like pauses occurred during the high response rate DRH schedules (DRH-12/2 and DRH-13/2, Fig. 1, Day 2, Subject S).

Although not shown, stimulus control and response rate remained stable for both Ss in the last three sessions. Each S could receive reinforcement under each leg of the multiple DRL-DRH schedule under requirements ranging from DRH-6/2, to DRH-13/2 and from DRL-3" to DRL-20".

Three-Man Teams

Five three-man teams were run under multiple DRL-DRH schedules. Since the results were highly similar, three representative teams are shown. The cumulative record is presented with the baseline. Individual team members' records are lined up with the team cumulative record. All of the three-man teams were initially conditioned on the DRH leg of the schedule since initial work had demonstrated that it was extremely difficult to bring the team rate up once a team had been shaped to respond at a low rate.

Team C-R-H (Fig. 2 and 3). This team was started out on a DRH schedule which required 10 responses in 3 sec (Fig. 2, Session I, Record 1). Since all members began by responding, DRH shaping was rapid and the team was responding at a rate of 16/3 within 10 min. Later in the day (Fig. 2, Session I, Record

2) the team was placed on a DRL-2". The cumulative response rate declined until the team achieved reinforcement under this schedule. The team was then shaped on various DRL schedules under the yellow S^D. A rate appropriate for receiving reinforcement on DRL-5" was achieved. Later, during Session I (Fig. 2, Records 3 and 4) the team was alternated back and forth on the multiple DRL-DRH schedule. The alternations were from DRH-17/3 to DRL-5", DRH-19/5, and DRL-5" and later from DRH-18/3 to DRL-5", DRH-18/3, and DRH-21/3. During this period the team alternated its rate each time the S^D light was changed. However, inspection of the individual Ss' records (Fig. 2, Session I, Records 3 and 4) indicated that Subject H is the only one who shifted response rates with the changes in S^Ds.

Figure 2, Session II, Records 5, 6, 7, and 8 indicated the same result. The team demonstrated shifts in rate appropriate to the multiple DRL-DRH schedule. However, again only Subject H shifted systematically with the changes in the multiple schedule. Inspection of Fig. 3, Sessions III, IV, and V, Records 9 through 15, indicates that only Subject H responded appropriately under the schedule shifts. Subjects C and R emitted bursts of responses which are not systematically under DRH or DRL control. When these periodic high response rates occurred during the DRL

Fig. 2. Individual and team cumulative response rates for team C-R-H, Sessions I and II.

Fig. 3. Individual and team cumulative response rates for team C-R-H, Sessions III, IV, and V.

segments of the multiple schedule, the team did not receive reinforcements. As the team conditioning progressed, less and less multiple schedule control was evident. By Sessions IV and V the teams emitted high and low rates under both the DRL and the DRH schedules.

Team K-M-S (Fig. 4). Figure 4, Session I, Record 1, shows how this team was initially shaped on the DRL leg of the schedule. A rate of 11 responses per 2 sec was obtained in 20 min. However, the team did not decrease

its rate when shifted to the DRL-2". During Record 2, Session I, the team was again placed on the DRH leg of the schedule and responded at the 11/2 rate. A second attempt to get DRL control produced only an occasional decline in team rate. This alternation of DRH and DRL schedules continued throughout the rest of the session. Each time DRL shaping was attempted, as for example a change from DRL-3" to DRL-5", the team reverted back to a high response rate. Inspection of the in-

Fig. 4. Individual and team cumulative response rates for team K-M-S, Sessions I, II, and III.

dividual records indicated that no individual Ss were under S^D control. During Sessions II and III the team demonstrated some response differentiation under the two legs of the schedule. However, the team response rate was more typical of that of a mixed schedule than that of a multiple schedule. Although the team shifted from DRH rates to DRL rates and from DRL rates to DRH rates, it was over a period of time ranging from 5 min to as long as 30 min. At no time did the team demonstrate immediate shifts in response rate when the S^D was shifted. Inspection of the records of individual team members indicated that at no time was any individual member under S^D control.

The team pattern for Sessions IV and V was similar to that developed in the first three sessions. Neither the team as a whole nor any individual team member was ever under consistent S^D control.

Team O-S-H (Fig. 5). The experimenters had access to individual records throughout the team shaping sessions. Fearing that this might be biasing their procedure, they shaped one team with only the cumulative team record available. Figure 5, Sessions I through IV, presents this cumulative team record. By Session IV this team demonstrated immediate shifts from DRL to DRH rates and from DRH to DRL rates, indicating good S^D control. During Session V the individual cumulative recorders were turned on to determine how individual Ss were responding. The bottom record of Fig. 5 presents the individual records for the three Ss during Session V. Inspection of the figure indicates that only Subject H was under S^D control. Subjects O and S were responding at a low rate under both DRL and DRH legs.

DISCUSSION

Comparison of team conditioning with the individually conditioned Ss indicated that multiple stimulus control can be achieved in individual Ss in 3 to 6 hr while it could not be effectively achieved in 15 hr of conditioning with teams when collective reinforcement was used. Although changes in the rate of response occurred in some teams when the legs of the multiple DRL-DRH schedules were shifted, the shifts often resembled the record of a mixed schedule of reinforcement rather than a multiple schedule record. That is, it took a considerable period of time before the team shifted its rate of response. In those teams (two out of five) in which immediate shifting occurred, only one S out of the three team members was under S^D control. The other team members demonstrated no differentiation in response rate under the two legs of the schedule.

One can only speculate as to whether adequate control could have been achieved with the teams if they had been run for longer periods of time. However, the lack of change from Session II to Session V indicated that further conditioning under the present conditions would have achieved little.

Fig. 5. Team cumulative response rates for team O-S-H, Sessions I, II, III, and IV. For Session V individual as well as team cumulative response rates are presented.

Another finding was that although the team was conditioned under a specific schedule, the individual team members displayed a variety of response rates. Only two team members out of 15 displayed the multiple DRL-DRH behavior that the experimenters attempted to shape. Various response rates were conditioned in the other team members. As long as the responses of any team member did not prevent occasional reinforcement for the team, his intermittent responding continued. The imposed variability allowed by collective reinforcement invariably led to incompatible behavior among the team members.

The results suggest that simple collective reinforcement is inefficient in team conditioning. Some type of individual feedback which informs the individual member of the team about his relative contribution to the team output seems to be necessary. Another possible solution would be to arrange the collective

reinforcement so that less variable response rates among team members would be reinforced.

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