EXTINCTION OF BAR PRESSING FOLLOWING TRAINING

UNDER A MULTIPLE VI VI SCHEDULE¹

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Gollub and Urban (1958) found that when animals had been trained under mult VI VI, the differences in the rate of response to the separate stimuli during training were accentuated during extinction. They trained pigeons on mult VI 3 VI 9, with the VI 3 stimulus present for 15 minutes and the VI 9 stimulus present for 45 minutes. All of their subjects responded at slightly higher rates during training in the presence of the VI 3 stimulus than in the presence of the VI 9 stimulus. Thus, their VI 3/VI 9 rate ratios were greater than one. During extinction, the stimuli were presented alternately every 12.5 minutes. The ratio of the response rates increased during extinction because of the more rapid decline of responding in the presence of the VI 9 stimulus. These authors point out that since there are no normative data for extinction following training on the simple schedules, the magnitude of the interaction under a multiple schedule cannot be identified.

Clayton (submitted for publication) reinforced rats for panel pushing under either a mult VI 15 sec. ext or mult VI 75 sec. ext, simple discrimination situations. She found only a slightly higher rate of response during training in the presence of the S^D for the VI 15 sec. animals than for the VI 75 sec. animals, and the variability was such that this difference was not statistically significant. During extinction, when the stimulus conditions were exactly like those of training except for the absence of reinforcement, this difference in rates was reversed and accentuated. The rate of responding for the VI 75 sec. animals fell off much more slowly than for the VI 15 sec. animals.

At least two explanations are possible for the difference between Clayton's finding and that of Gollub and Urban. One explanation is that interaction effects between the VI schedules appeared in the Gollub and Urban study when each animal was given training on both schedules. Presumably, Clayton would have also encountered interaction effects in the mult VI ext schedules she used which would cause a higher rate of response during training for both groups during the VI component than for animals on simple VI schedules. Ferster (1958) and Reynolds (1961) have reported such interactions. One mult VI ext schedule might yield a different extinction curve from another mult VI ext schedule. However, this difference might not hold if the two VI schedules had been combined in a mult VI VI schedule for a single animal.

The second explanation involves the fact that the

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extinction conditions in the Clayton study were exactly like those during training except for the lack of reinforcement. In the Gollub and Urban study, on the other hand, the durations of the stimuli were changed during extinction; furthermore, they were changed more for the VI 9 stimulus than for the VI 3 stimulus. This change might result in the more rapid diminution in rate during the VI 9 stimulus.

In this study, we hoped to discriminate between the two explanations by reinforcing rats for bar pressing on a mult VI 15 sec. VI 75 sec. schedule and then extinguishing the response under stimulus durations either like those of training or with a decrease in one of the stimulus durations.

SUBJECTS AND PROCEDURE

The subjects were four male, albino rats, approximately 90 days old at the beginning of the experiment. They had previously been used in a study in which they were given continuous reinforcement for bar pressing, and then this response had been partially extinguished. White noise was used as a masking stimulus during this previous experiment. They had been on food deprivation for approximately 30 days at the beginning of the present experiment, receiving, daily, 11 grams of dry ground chow mixed with water. At the beginning of the present experiment, this ration was decreased to 8 grams daily, which was used throughout the study.

The apparatus was a Grason-Stadler operant-conditioning chamber enclosed in a sound-resistant ice chest. During the first experimental session, the animals were permitted to make 25 continuously reinforced bar presses in order to recondition the response. The white noise was present during this session. During the following nine sessions, the animals were reinforced on a mult VI 15 sec. VI 75 sec. schedule, white noise serving as the stimulus for the VI 15 sec. schedule. The white noise was absent while the VI 75 sec. schedule was in effect. The noise was present for 1.25 minutes and then was absent for 6.25 minutes, keeping the numbers of reinforcements obtained under each schedule approximately constant. Two of the animals, selected at random, received extinction under these same stimulus durations. For the other two animals, noise was present and absent for equal periods of time (1.25 minutes) during extinction. Extinction was continued for two 60-minute experimental sessions, when it was discontinued because of the low response rates.

RESULTS AND DISCUSSION

Table 1 presents the mean rates of response per session under each of the stimulus conditions, as well as the ratios of these rates, for the last three training sessions. Data are presented for three sessions in order to indicate the amount of variability in the rates. Although the variability in the rates and ratios among subjects and from session to session is considerable, the rate of response is clearly higher in the VI 15 sec. condition than in the VI 75 sec. condition. The ratios of the rates are the same or slightly higher than those found by Gollub and Urban.

Table 1

Mean Rates and Rate Ratios of Bar Pressing Under Each of the Stimulus Conditions During the Last Three Training Sessions

Subject*	VI 15 Sec.	VI 75 Sec.	VI 15 Sec. Rate
	(Mean Rates)		VI 75 Sec. Rate
7th Training Session			
S 1	15.30	9.64	1.59
S 2	21.10	12.24	1.72
S 3	25.44	14.37	1.77
S 4	21.40	8.10	2.64
8th Training Session			
S 1	15.60	10.46	1.49
S 2	19.90	13.42	1.48
S 3	30.25	11.36	2.66
S 4	24.40	7.12	3.43
9th Training Session			
S 1	23.40	11.60	1.72
S 2	20.60	15.80	1.30
S 3	32.90	15.10	2.18
S 4	25.80	9.00	2.87

*In these sessions, extinction conditions for Subjects S1 and S2 were S; and those for Subjects S3 and S4 were D.

The responses of S1 and S2 were extinguished under the same conditions as were present during training, and those of S3 and S4 were extinguished under conditions of equal durations of VI 15 sec. and VI 75 sec. stimuli. The extinction results are presented in Table 2. Subjects S1 and S2 are labeled S for Same extinction conditions, whereas Subject S3 and S4 are labeled D for Different extinction conditions.

The results for the S subjects reveal a slight increase in the rate ratios during extinction, indicating a slightly slower drop in the rate of response during the VI 15 sec. stimulus than during the VI 75 sec. stimulus. This is contrary to the results of the Clayton discrimination study in which these same schedules were used in mult VI ext schedules for separate groups of animals. These results would clearly indicate an interaction between the VI schedules which has consequences during extinction. This effect is not so large as that found by Gollub and Urban. In their study,

Table 2

Rates of Response and the Ratios of the Rates During Extinction of a Multiple Schedule

Subject*	VI 15 Sec.	VI 75 Sec.	VI 15 Sec. Rate
	(Mean Rates)		VI 75 Sec. Rate
First Half of First Extinction Session			
S 1	15.60	7.24	2.15
S 2	21.20	9.48	2.24
S 3	23.46	13.54	1.73
S 4	12.47	5.06	2.46
Total, First Extinction Session			
S 1	9.50	4.46	2.11
S 2	14.10	5.60	2.52
S 3	17.40	10.30	1.69
S 4	8.70	3.20	2.72
Total, Second Extinction Session			
S 1	6.40	2.40	2.67
S 2	2.60	1.30	2.00
S 3	7.20	5.40	1.33
S 4	3.40	1.70	2.00

*In these sessions, extinction conditions for Subjects S1 and S2 were S; and those for Subjects S3 and S4 were D.

the ratios during extinction were two to three times the size of those found during training as a consequence of the drop in the response rate during the VI 9 stimulus. Another difference between these results and those of Urban and Gollub is that the rate ratios for the two animals of the S group do not tend to increase consistently as extinction progresses. This would seem to indicate that under the present conditions, the accentuated difference between the rates appears early in extinction; but, following that, the response rates tend to decrease at the same rate.

The results of the D group were not at all according to prediction. Decreasing the duration of the VI 75 sec. stimulus during extinction was expected to result in a more rapid diminution in response rate during this stimulus, so that the ratios of the rates during the two stimulus conditions would be accentuated. However, an examination of Table 2 will show that this did not occur. In fact, the ratios of the rates during extinction are consistently below the ratios during the last training session. With one exception (S3 during the 7th training session), the ratios of the two animals are below their training ratios for the three final training sessions. Because these were, by chance, the two most variable animals during training, it is hard to say whether changing the conditions during extinction really decreased the rate ratios or whether it simply had no effect. The finding warrants further investigation.

SUMMARY

Four albino rats were reinforced for bar pressing on a mult VI 15 sec. VI 75 sec. schedule. The duration of

the VI 15 sec. stimulus was 1.25 minutes per presentation, whereas that of the VI 75 sec. stimulus was 6.25 minutes. Two of the animals (S) were given extinction under stimulus durations like those of training; and the other two animals (D) were given extinction under equal stimulus durations (1.25 minutes). The results indicate that the ratios of the response rates for the S animals were accentuated during extinction, the rate of response being higher during the VI 15 sec. stimulus. Changing the conditions during extinction for the D animals either had no effect on their rate ratios during training or it decreased these ratios.

REFERENCES

- Clayton, Frances L. Two measures of the "Cue Strength" of a stimulus and its conditioned reinforcing value. (Submitted to *J. exp. Anal. Behav.*)
- Ferster, C. B. Control of behavior in chimpanzees and pigeons by time out from positive reinforcement. *Psychol. Monogr.*, 1958, **72**, No. 8 (Whole No. 461).
- Gollub, L. R., and Urban, J. T. The accentuation of a rate difference during extinction. *J. exp. Anal. Behav.*, 1958, **1**, 365-369.
- Reynolds, G. S. Behavioral contrast. *J. exp. Anal. Behav.*, 1961, **4**, 57-71.

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