OBSERVING RESPONSES IN PIGEONS: EFFECTS OF SCHEDULE COMPONENT DURATION AND SCHEDULE VALUE¹

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Pigeons were exposed to a procedure under which five pecks on one response key (the observing key) changed the schedule on a second key (the food key) from a mixed schedule to a multiple schedule for 25 sec. In Experiment I, a random-ratio 50 schedule alternated with extinction. The duration of the random-ratio 50 schedule component was varied between 1.25 and 320 sec, and extinction was scheduled for a varying time, ranging from the duration of the random-ratio 50 to four times that value. Each set of values was scheduled for a block of sessions. Before observing-key pecks were allowed at each set of parameter values, the pigeons were exposed to a condition where the mixed and multiple schedule alternated every 10 min, and observing-key pecks were not permitted. Rates of pecking on the observing key were high for all values of random-ratio component durations except 1.25 sec. Experiment II was conducted with the random-ratio component duration equal to 40 sec, and the random-ratio schedule was varied from random-ratio 50 to 100, 200, and 400. Observing-key pecking rates were high for all values of the random-ratio schedule except random-ratio 400. In both experiments, observing response rates were relatively little affected, suggesting that neither schedule component duration nor schedule value is a strong determinant of observing responses.

Observing responses are responses that produce discriminative stimuli (Wyckoff, 1950, 1952). In Wyckoff's original procedure, pigeons could press a treadle that produced stimuli correlated with either a fixed-interval (FI) 30-sec schedule of food reinforcement or with extinction. Operation of the treadle did not change the alternation of FI 30-sec and extinction components, but only produced a stimulus that indicated which component was currently in effect. In the terminology of Ferster and Skinner (1957), an observing response temporarily changes a mixed (*mix*) schedule to a multiple (*mult*) schedule.

Some investigators have argued that presentation of the stimulus correlated with more

frequent food delivery is a necessary condition for the maintenance of observing responses (e.g., Dinsmoor, Browne, and Lawrence, 1972; Kendall and Gibson, 1965; Wilton and Clements, 1971), whereas others suggest that a stimulus correlated with extinction functions as a reinforcer in observing response situations (e.g., Lieberman, 1972).

These seemingly contradictory opinions indicate that the variables responsible for the maintenance of observing responses remain undetermined. One method for gaining insight into relevant behavioral variables is the systematic manipulation of the parameters of a procedure (Sidman, 1960). Experiments of this type are relatively sparse in the literature on observing responses (Kelleher, 1958; Kelleher, Riddle, and Cook, 1962; McMillan, 1972). The present experiments involved manipulating two of the parameters of an observing response procedure, the duration of time that either a schedule of food availability or extinction is in effect and the value of the food schedule itself.

EXPERIMENT I

If one component of a mixed schedule is extinction, it is probable that lengthening the duration of mixed schedule components can

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affect the behavior, in that the discriminative properties of food delivery may be enhanced. For example, if the two schedules used were a variable-interval schedule of food availability and extinction, and the component durations were relatively long, then the delivery of food would serve as an event that precedes a long period of time during which the variable-interval schedule is in effect, and thus could control response rates. Similarly, if no responses have been followed by food for a substantial period of time, then extinction is probably in effect and will remain so for a time, and, again, response rate might be affected. If response rates were controlled by the presence or absence of response-produced access to food, then the number of responses per food delivery under a mixed schedule would be decreased. In most observing response procedures, making observing responses reduces the total number of responses per food delivery, and it is possible that this fact is important for the maintenance of observing responses.

The present experiment examined the possibility that component durations in a multiple schedule affect the behavioral properties of the multiple schedule stimuli. This was accomplished by varying the duration of the components in a two-component multiple schedule over a wide range and analyzing the effect of this manipulation on observing responses.

A feature of the present experiment that is lacking in all but one of the published reports on observing responses (Steiner, 1967) is that, here, behavior under both the multiple schedule and the corresponding mixed schedule was allowed to develop at each parameter value before observing responses were permitted. Traditionally, observing responses are established by first obtaining multiple schedule control of responding and then exposing the animal directly to the observing response procedure. A result of this latter technique is that the stimulus correlated with the mixed schedule is not encountered until observing responses can be made, and generally very little responding on the food-producing operandum occurs in the presence of the mixed schedule stimulus. McMillan (1972) and Branch (1970) have shown that establishing food-key responding in the presence of the mixed schedule stimulus can produce both qualitative and quantitative changes in performance on an observing key.

METHOD

Subjects

Four experimentally naive, male Auto-sexer pigeons, obtained from the Palmetto Pigeon Plant, were maintained at approximately 80% of their free-feeding weights and were housed in individual cages. Water and grit were available in the home cages.

Apparatus

Sessions were conducted in a two-key pigeon chamber, 30 cm wide by 31 cm long by 31 cm deep (12 by 12.5 by 12.5 in.). The aluminum wall upon which the keys were mounted was housed inside a sound-attenuating box. One key was designated as the food key and could be lighted by red, green, or blue light. The other key was designated as the observing key and could be lighted white. The center of the food key was 22 cm (9 in.) from the floor, and 8 cm (3.5 in.) to the right of the center of the observing key. Pecks on either key with a force exceeding about 15 g (0.15N) were followed by a click of a relay mounted behind the panel and were recorded as responses.

Access to a solenoid-controlled grain feeder was provided by a rectangular, 6 by 5-cm hole (2.5 by 2 in.) located 10.5 cm (4.25 in.) below the food key. When the grain feeder was operated, it provided access to grain for 3.0 sec, and all lights in the chamber were extinguished except for a 1.2-W lamp over the grain. General illumination of the chamber was provided by two shielded, 1.2-W bulbs located in the upper corners of the aluminum panel.

The experiment was monitored and controlled by solid-state switching and timing equipment (K-Logic, Digital Equipment Corporation) located in an adjoining room. Data were recorded on electromechanical counters and two cumulative response recorders. White noise was provided in the room in which the chamber was located.

Procedure

The pigeons were trained to eat from the grain feeder, and then to peck the food key. After exposure to several random-ratio (RR) schedules (*i.e.*, schedules in which each peck had an equal probability of producing access to grain, where the value of such schedules is defined as the expected number of responses

per reinforcement; Brandauer, 1958), and multiple random-ratio extinction schedules, the pigeons were exposed to the first condition of Experiment I.

The food-availability schedules used in this experiment were RR 50 and extinction. The durations of each component were determined by a time value, t , and a probability generator set at $p = 0.5$. Each RR 50 component lasted t sec, and each extinction component lasted t , $2t$, $3t$, or $4t$ sec, depending on the state of the probability generator that produced an outcome every t seconds while extinction was in effect. The expected value of extinction-component durations was $1.625 t$ sec.

Two basic procedures were used over the course of Experiment I. Under the first procedure, *mix* RR 50 EXT alternated every 10 min with *mult* RR 50 EXT. That is, 10-min periods during which the food key constantly was lighted blue (the mixed-schedule stimulus) while RR 50 and extinction components succeeded one another according to the value of t , alternated with 10-min periods during which a red keylight and a green keylight were correlated with RR 50 and extinction components, respectively. The timer that produced t and the timer that produced the 10-min alternations of the mixed and multiple schedules were independent. Under the second procedure, which was instituted after rates had stabilized under the first procedure, the observing key was lighted white when the food key was blue (*i.e.*, during *mix* RR 50 EXT). Five pecks (FR 5) on the observing key turned the light off behind that key and produced the multiple schedule for 25 sec. If the schedule changed from RR 50 to extinction, or *vice versa*, within 25 sec of a completed sequence of five pecks on the observing key, then the color of the food key changed appropriately. If no observing responses were made, then *mix* RR 50 EXT was in effect for 100% of the session. Pecks on the observing key had no effect on the program of alternation of RR 50 and extinction. No changeover delay was used.

The time value, t , took on the values 160, 80, 40, 20, 10, 5, 1.25, and 320 sec, in that order. A block of sessions was conducted under each of the two procedures for each of the values of t . Table 1 shows the number of sessions under each condition for each value of t .

Upon first exposure to the observing response procedure, three pigeons (Pigeons B1,

Table 1

Sequence of experimental conditions and the number of sessions in each condition.

t (sec)	Number of Sessions	
	Mixed and Multiple Alternate every 10 min	Observing Responses Allowed
160	25	20
80	16	13
40	22	17
20	8	12
10	10	10
5	6	7
1.25	5	13
320	19	18

B2, and B4) all pecked the observing key within 30 sec of the beginning of the first session, whereas the behavior of the remaining pigeon (Pigeon B3) was shaped with food until it pecked the observing key, because no pecks occurred during the first 10 min of exposure. In this first session only, one peck was required on the observing key to produce the multiple schedule. During the second session, the response requirement was increased, in steps, to five, and remained there for all other sessions.

The value of t was changed when the proportion of time that the multiple schedule was kept in effect was stable for five consecutive sessions for all four pigeons. Stability was determined by inspection of a plot of the session means, and observing behavior was considered stable when these plots showed no trend. Sessions were held daily, and each session lasted approximately 64 min.

RESULTS

Figure 1 shows the mean percentage of the session the multiple schedule was in effect as a function of t , the minimum duration of a component of RR 50 or EXT, for each of the four pigeons. Over a range of RR 50 component durations from 5 to 320 sec and a range of extinction durations from 5 to 1280 sec, mean observing response output was largely unchanged. However, when t was extremely short, *i.e.*, 1.25 sec, observing behavior was greatly reduced. For Pigeons B1 and B3, observing response output decreased to almost zero when t equalled 1.25 sec, but under this parameter value all pigeons pecked at increased rates in the presence of the mixed schedule stimulus compared to their rates under other values of t .

Fig. 1. Mean percentage of the session that the multiple schedule was in effect as a function of t , the duration of each component of RR 50 and the minimum duration of each component of extinction (EXT). Each set of coordinates is for a separate pigeon. Each point represents the mean from the last five sessions of exposure to a particular value of t , and the vertical bars indicate the range of the session means over the last five sessions. Note that the scale on the abscissa is logarithmic.

An aspect of the behavior not shown in Figure 1 is the abruptness of the decrease in observing response output when t was 1.25 sec. After a few sessions (8, 8, 3, and 5 sessions for Pigeons B1, B2, B3, and B4, respectively) of exposure to the observing response procedure with t equal to 1.25 sec, all four pigeons showed a precipitous drop in observing response rate. The percentage of the session that the multiple schedule was in effect dropped 54% between two sessions for Pigeons B1 and B4, 50% for Pigeon B2, and 44% for Pigeon B3. Accompanying these large reductions in observing behavior were immediate increases in the overall rate of pecking on the food key in the presence of the mixed schedule stimulus.

Pecking rates on the observing key were generally quite uniform throughout the session, which was characteristic of performance when t was in the range from 5 to 160 sec. The five responses required to produce the multiple-schedule stimuli were almost always completed in a rapid sequence.

Fig. 2. Mean response rates on the food key as a function of t when the multiple schedule was in effect. Each set of coordinates is for a single pigeon. The filled circles depict rates during RR 50, and the open circles rates during extinction. Each point is the mean from the last five sessions at each t value, and the vertical bars indicate the ranges of the session means over these last five sessions. Note that the scale on the abscissa is logarithmic.

Figure 2 presents response rates on the food key in the presence of the stimuli that were produced by observing responses. When t was equal to 1.25 sec, response rates in the presence of the stimulus correlated with extinction (open circles) were increased. However, different response rates were controlled by the two stimuli under all values of t . Stimulus control was not eliminated.

Figure 3 displays the relationship between t and a "discrimination index" computed from the response rates during the mixed schedule. These data are from the conditions where the mixed and multiple schedules alternated every 10 min, and the "discrimination index" was calculated using the following formula,

$$DI = \frac{r_1}{r_1 + r_2}$$

where r_1 was the key-pecking rate while RR 50 was in effect and r_2 the rate during times extinction was scheduled. This index can vary from zero to 1.0. A value of 0.5 results if $r_1 = r_2$, and values larger than 0.5 indicate that r_1 is larger than r_2 , e.g., a value of 0.67 reveals that r_1 is twice r_2 . As shown in Figure 3, the "discrimination index" for mixed schedule responding generally increased as t increased,

Fig. 3. A "discrimination index" as a function of t for rates during the mixed schedules. Each set of coordinates is for a single pigeon. The data are from the conditions in which the mixed and multiple schedule alternated every 10 min. Each point is the mean from the last five sessions under each t value, and the vertical bars show the ranges of the daily values for the last five sessions. Note that the scale on the abscissa is logarithmic.

with the highest point on the functions occurring when t was 320 sec. The large increase in the "discrimination indexes" when t was 320 sec was mainly due to an increase in rate during times when RR 50 was scheduled, and rates while extinction was in effect were not

much changed at this value of t . Figure 4 shows in more detail the performance during the mixed schedule when t was 320 sec. This figure shows segments of a cumulative response record for Pigeon B3 from the last session of the condition under which the mixed and multiple schedules alternated every 10 min and t was 320 sec. These segments are from the 30 min of exposure to *mix* RR 50 EXT. The small letters "a" indicate transitions to a high, steady rate, which happened when food was delivered after a long period in which no responses had produced food.

The data presented in Figure 1 show that average observing response output when t equalled 320 sec was about the same as it was when t took on other values, except 1.25 sec. Figure 5 shows that when t was 320 sec, observing response rate was not constant throughout the session, as was the case at values of t between 5 and 160 sec. This figure presents cumulative response records of both food-key and observing-key responses from the last session under which t was 320 sec. The changes in local observing rates were most regular in Pigeons B3 and B4. These two pigeons often did not respond on either key at the beginning of extinction periods. Pigeons B1 and B2 did not peck the observing key

Fig. 4. Three 10-min segments of a cumulative response record generated by Pigeon B3 when t was 320 sec. The record is from the last session under the procedure in which the mixed and multiple schedules alternated every 10 min, and the segments shown are from periods when *mix* RR 50 EXT was in effect. The pen was deflected down when extinction was scheduled, and the short diagonal marks indicate deliveries of food.

Fig. 5. Cumulative response records of food-key and observing-key pecking from the last session in which t was 320 sec. Each frame presents two records from a single pigeon. The top record of each pair is from the food key. The pen was deflected downward when extinction was scheduled and short diagonal marks indicate delivery of food. The bottom record of each pair is from the observing key and short diagonal marks on this record represent the beginning of a 25-sec period during which the multiple schedule was in effect. The time axes have been collapsed for compact presentation. The two recorders reset to the baseline at the same time so the records have been aligned such that the time axes correspond within each pair of records.

either on some occasions, but these pauses were not as well correlated with the beginning of schedule components.

Although Figure 1 suggests considerable comparability among pigeons, the rates of ob-

serving responses during times when RR 50 was scheduled and rates when extinction was scheduled were often different, and the relationships between the two rates were different for different pigeons. Pigeons B1 and B3 had higher observing response rates when RR 50 was scheduled than when extinction was scheduled over t values from 10 to 320 sec, whereas Pigeon B2 had higher rates when extinction was scheduled over this range of t values. These differences in observing response rates were extremely reliable. There was not a single reversal of these rate differences in any session over the range of t values specified. Pigeon B4 did not show any consistent rate differences across values of t .

DISCUSSION

One of the principal objectives of varying component duration in this experiment was to enhance the discriminative properties of food delivery. Figures 3 and 4 show that manipulation of component duration was an effective way to alter the discriminative properties of grain delivery with the schedules used here. This outcome was desired in order to examine the possibility that stimulus control of response rates by food delivery might interfere, or interact, with stimulus control of key pecking by colored keylights in such a way as to make observing responses less probable. One result of increasing the discriminative properties of food delivery was that the ratio of responses to grain presentations under the mixed schedule was changed. Total observing response output, nevertheless, was not changed. Only local observing response rates were affected. It is, of course, possible that the ratio of responses per food delivery under the mixed schedule was not changed enough to affect observing responses. Directly manipulating this variable would allow a wider range of values to be examined.

A number of experiments (Hendry, 1969, pp. 312-313; Kelleher, 1958; Wyckoff, 1969, 1950) have shown that the frequency of observing responses can be greatly reduced if the multiple schedule stimuli stop controlling differentiated performances. In the present experiment, when t was 1.25 sec, there was some disruption of stimulus control of food-key pecking, and observing responses were reduced in frequency. The change in stimulus control obtained here, however, is nowhere

near the magnitude of the changes reported in the previous experiments. An analysis of the relationship between degree of stimulus control and observing responses is needed.

Another possibility is that the effectiveness of the stimulus correlated with RR 50 as a conditioned reinforcer may have diminished when t was 1.25 sec because fewer individual presentations of the red key were associated with food delivery. When t was 1.25 sec, only about one in 20 individual presentations of the red key was associated with a peck being followed by food delivery (assuming a rate of two pecks per second).

Other experiments have shown differences in observing response rates during times when extinction is scheduled *versus* times when responses can produce food (Branch, 1970; Kelleher *et al.*, 1962). Branch (1970) used VI 30-sec and extinction as schedules, whereas Kelleher *et al.* (1962) used VR 100 and extinction as schedules. Branch reported that his pigeons had higher observing rates when VI 30-sec was scheduled, and Kelleher *et al.* showed that their pigeons had higher observing rates when EXT was scheduled. The present experiment failed to replicate reliably either Branch or Kelleher *et al.* with respect to this rate difference. No variables were found that were correlated with these rate differences, so the reasons for the differences among pigeons remain undiscovered.

EXPERIMENT II

The relative insensitivity of observing response output to changes in component duration leads to an additional conceptualization of the observing response procedure used in Experiment I.

It is possible that the paradigm used in Experiment I is merely a complicated method for arranging what is, in essence, a two-component chained schedule (*chain*) of reinforcement (Ferster and Skinner, 1957). A two-component chained schedule involves two reinforcement schedules, each correlated with a different exteroceptive stimulus. Completion of the requirements of the first schedule results in presentation of the second schedule and its associated stimulus, and presentation of a primary reinforcer then depends on meeting the requirements of the second schedule. In the observing response procedure used in Ex-

periment I, five pecks on the observing key in the presence of the mixed-schedule stimulus resulted in a 25-sec presentation of either a red key correlated with RR 50 or a green key correlated with extinction. The schedules in effect in Experiment I, then, could be labelled *chain* FR 5 RR 50 and *chain* FR 5 EXT. The mean probability of a response producing access to grain during the 25-sec exposure to the multiple schedule was generally constant for all values of t in Experiment I, except when t was 1.25 sec. When t was 1.25 sec, more responses occurred in the presence of the stimulus correlated with extinction and thus the probability was decreased. If pecking on the observing key is a function of the overall probability of food presentation on the food key, then manipulation of component duration would have no effect.

The purpose of Experiment II was to examine this possibility by varying the probability that a response would produce access to food in the random-ratio schedule. Several experiments have shown that changing the frequency of food delivery in the last component of chained schedules will influence the behavior in earlier components (*e.g.*, Findley, 1962). Reducing the frequency of food delivery in the second component of a two-component chained schedule generally produces a monotonic decrease in response rate in the first component (Kelleher, 1966). If pecking on the observing key is analogous to behavior in the first component of a two-component chained schedule, then reducing the frequency of food availability in the second component, *i.e.*, in the multiple schedule, ought to reduce the rate of responding on the observing key.

METHOD

Subjects

Pigeons B1, B2, B3, and B4 were used again. Their living conditions were the same as those in Experiment I.

Apparatus

The apparatus was the same as that used in Experiment I.

Procedure

Experiment II began immediately after Experiment I. The procedure was identical to the procedures under which observing responses were allowed in Experiment I when t was 40

sec, except that the random-ratio schedule was varied. That is, the random-ratio components lasted 40 sec and the EXT components lasted 40, 80, 120, or 160 sec, depending on the out-

comes of the probability generator. The random-ratio schedule and extinction alternated in the presence of a blue light behind the food key if no observing responses were made. If

Fig. 6. Percentage of the session that the multiple schedule was in effect plotted over sessions.

five pecks (FR 5) were made on the observing key, a multiple schedule was put into effect for 25 sec.

The random-ratio schedule was first RR 50, replicating a condition from Experiment I. Next, the schedule was changed to RR 100, then to RR 200, then to RR 400, and for Pigeons B1 and B2, to RR 100 again. The random-ratio schedule was changed when observing response output was judged stable using the same criterion as that used in Experiment I. This criterion resulted in the following number of sessions at each value of the random ratio: RR 50 – 10 sessions, RR 100 – 8 sessions, RR 200 – 12 sessions, RR 400 – 27 sessions (24 sessions for Pigeons B3 and B4), RR 100 – 10 sessions.

RESULTS

Figure 6 illustrates the effects on observing responses of changing the random-ratio schedule. Pigeons B1 and B2 showed no change in observing response output, defined as percentage of a session that the multiple schedule was in effect, as the random-ratio schedule was changed from RR 50 to RR 100 to RR 200. Pigeon B4 seemed to exhibit a slight decrease when the schedule was RR 200, and Pigeon B3 showed a very slight decrease at both RR 100 and RR 200. Changing the schedule from RR 200 to RR 400 had a large effect on the observing-response output of Pigeons B3 and B4, and a moderate effect on the performance of the other two pigeons. In all cases, the change from RR 200 to RR 400 reduced observing behavior.

After the fifty-fourth session of Experiment II, Pigeons B3 and B4 were involved in a cage accident that resulted in the death of Pigeon B3 and injuries to Pigeon B4, which prevented its use in the remainder of the experiment.

Figure 7 depicts the effects of random-ratio value on response rates on the food key while the multiple schedule was in effect. Response rates during extinction (open circles) were not changed, even when the schedule was RR 400, and there was a clear difference between response rates in the presence of the two multiple-schedule stimuli throughout. The response rates for Pigeons B2 and B4 were largely unchanged by modification of the random-ratio schedule, except for a transient reduction in rate during the random-ratio

component of the multiple schedule over the early sessions of the RR 400 condition. Pigeons B1 and B3, in contrast, showed rate reductions during the random-ratio component when the schedule was changed from RR 100 to RR 200, and also when it was changed from RR 200 to RR 400. Pigeon B4's rate, however, returned to a high level near the end of the RR 400 condition.

DISCUSSION

These results suggest that the observing response procedure used here is not just an indirect method of arranging a two-component chained schedule. The frequency of food delivery was markedly reduced, by a factor of at least four, as the schedule was changed from RR 50 to RR 200, yet there was very little change in behavior on the observing key. For Pigeons B1 and B2, the further decrease in frequency of access to grain as the schedule was changed to RR 400 had a relatively small, though reliable, effect. Few data have been reported describing the effect of parameter values in the first component of two-component chained schedules, and it is possible that the use of FR 5 in the present experiment was important in determining the results.

The response rate data of Figure 7 extend the findings of Sidley and Schoenfeld (1964), who showed that key-pecking rates were largely unchanged as a random-ratio schedule was varied from RR 10 to RR 150. In the present experiment, response rates on the food key changed little as the schedule was varied from RR 50 to RR 200, and for three of the pigeons the rate changed little when the random ratio was further increased to RR 400.

GENERAL DISCUSSION

Observing response output was generally insensitive to large changes in either component duration or schedule value. Several measures changed as a function of the two parametric manipulations performed here. Experiment I showed that substantial changes in the discriminative properties of food delivery did not result in any changes in overall observing response rate, though local response rates on the observing key did change. In Experiment II, both frequency of food delivery and the number of responses per operation of the food magazine changed greatly as the schedule was

Fig. 7. Response rates on the food key during times when the multiple schedule was in effect plotted over sessions. The filled circles indicate rates during the random-ratio schedules and the open circles the rates during extinction.

varied from RR 50 to RR 200. Yet, again, observing response rate was virtually unchanged, indicating that under the present conditions, neither the frequency of food delivery nor the probability that a response will produce food was a critical variable in the maintenance of observing responses. These two variables do have an effect on observing responses in the extreme. McMillan (1972)

showed that if there is no food delivery at all, then observing responses are not maintained. It appears, nevertheless, that these two variables can be manipulated over a fairly wide range without affecting observing responses.

In Experiment I, there was a change in stimulus control when t was 1.25 sec, and it was at this parameter value that observing responses were reduced greatly in frequency.

When the schedule was RR 400 in Experiment II, the differences in rates during the random-ratio component and the extinction component were reduced, and observing rates were also reduced. These data suggest that strong stimulus control is needed to establish and sustain observing behavior. Additional support for this hypothesis comes from data reported by Wyckoff (1969, 1950) who studied observing responses during the acquisition of stimulus control. He found that observing responses occurred most frequently after stimulus control had been established. It should be recalled, of course, that even though stimulus control was reduced when t was 1.25 sec, it was not eliminated.

Although making observing responses always reduced the number of responses emitted per food presentation in these experiments, "saving of responses" does not seem to be of crucial importance in establishing and maintaining observing responses for several reasons. The first is the rapidity with which observing responses were acquired. Three of the pigeons pecked the observing key early in the first session in which that key was available, and continued to peck the observing key for the remainder of the experiment. If "saving of responses" were critical it might be expected that acquisition should be more gradual, since some time would have to pass in order for the pigeons to be exposed to the fact that fewer total responses were emitted if observing responses were made. A second reason is that, in Experiment I, changing the amount "saved" by observing responses, by changing the discriminative properties of food delivery, did not have a large effect on observing response output. As mentioned earlier, however, it is possible that the changes brought about were not large enough to produce a reliable effect. A third point is that in the one case in which observing response rate was greatly reduced, when t was 1.25 sec in Experiment I, it was still the case that when observing responses were made, fewer total responses were made per food delivery than when observing responses were not made.

In an experiment quite similar to Experiment II, Lieberman (1972) showed that observing response rate declined slightly as the variable-ratio (VR) component of a VR-extinction schedule was changed from VR 50 to VR 5. He interpreted the decrease as a result

of the added source of information provided by food delivery as the VR schedule was made less intermittent. In Experiment I here, food delivery controlled pecking on the food key as shown in Figures 3 and 4 (according to Hendry, 1969, stimuli are informative if they control differentiated performances), yet observing response output was not much affected, if at all. The data from Experiment I, especially with t equal to 160 or 320 sec, do not agree with Lieberman's hypothesis concerning the role of added information provided by food delivery.

The results of Experiment I showed that observing behavior could be disrupted by rapid alternation of the two components of a multiple schedule, and the only consistent behavioral byproduct of this manipulation was a small disruption of stimulus control. Perhaps strong stimulus control is necessary for the maintenance of observing responses. It is also possible that with t equal to 1.25 sec, rate of component alternation exerted a direct influence on observing response output, rather than producing its effect indirectly through the modification of stimulus control. If this is true, then the decline in observing response frequency when t was 1.25 sec indicates that a limit of some sort had been exceeded. Taken together, the results of these two experiments suggest that observing responses are quite resistant to changes in schedule parameters.

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