FREE-OPERANT BEHAVIOR UNDER CONDITIONS OF DELAYED REINFORCEMENT. I. CRF-TYPE SCHEDULES

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It has been suggested that an important determinant of the effects of drugs on behavior is the frequency of occurrence of the response under study under control conditions, i.e., in the absence of drug (Dews, 1958). It is therefore of pharmacological interest to study means of modifying the over-all tendency to respond. Long ago, Skinner (1938, p. 139) showed that delay of reinforcement led to a lowering of rates of response of rats working on a fixed-interval schedule of reinforcement, although it did not clearly interfere with conditioning on a CRF procedure (Skinner, 1938, p. 72). The present experiments were similar in conception to those of Skinner, but differed in the following particulars:

1. They have been performed on pigeons. The response used, the peck, seems to be naturally discrete and brief. A lever press by a rat, as used by Skinner, can, on the other hand, have appreciable and varying duration. Skinner defined the response as the initial depression of the lever, but this introduces an arbitrariness that is almost completely circumvented when the peck of a pigeon is used as a response.
2. The basic schedule was CRF in type, in that every response was potentially reinforced. Perhaps partly because of this, longer periods have been able to be studied (10, 30, and 100 seconds) as compared with Skinner's (2, 4, 6, and 8 seconds). Skinner used the CRF procedure only in studies on acquisition.
3. The effects of permitting additional responses to be made during the "delay" period has been studied explicitly.

Ferster has studied the effects of delay of reinforcement on the rate of responding of pigeons working on a 1-minute variable interval of reinforcement (VI 1 min) (Ferster, 1953). He introduced the device of completely darkening the experimental space during the period between the occurrence of the response-to-be-reinforced and the presentation of the reinforcing stimuli. Under these conditions, Ferster was able to gradually introduce delays of reinforcement of up to 60 seconds without appreciable reduction in rate as compared with that on simple VI 1 min. The occurrence of darkening of the experimental space may be expected to have acquired conditioned reinforcing properties in these experiments, and so they are not comparable with those of Skinner or with the present series.

The schedules used in the present work may be conveniently viewed as related to the converses of the familiar DRL- and FI-type schedules. In a DRL x sec schedule the reinforcer is presented when the sequence " x seconds without a response and then a response" has occurred. In an FI x sec schedule the reinforcer is presented when the sequence "elapse of x seconds (during which time responses are without programmed consequence) and then a response" has occurred. The schedules now to be described are of two types. In one type (type N1 $\overline{\text{Tx}}$ ", see below), the reinforcer was presented when the sequence "a response, and then x seconds without a response" had occurred. In the other type (type N1 Tx", see below), the reinforcer was presented when the sequence "a response and then the elapse of x seconds (during which time responses were without programmed consequence)" had occurred.

MATERIALS AND METHODS

The experiments were conducted on five White Carneaux pigeons maintained at 80% of body weight on unlimited food. A standard pigeon apparatus was used (Ferster & Skinner, 1957, p. 14) with the usual response key and reinforcing mechanism.

Schedules

The basic schedule was that a response started a fixed-period timer, and at the conclusion of the timing cycle the food magazine was operated. There were two variants of this basic schedule: type N1 $\overline{\text{T}x}$ ", in which responses during the x-second timing cycle "re-set" the timer (the symbol N1 signifies that a response was necessary to start the timer, and the bar over Tx" signifies "without a response"); and type N1 Tx", in which, when the first response following a reinforcement had started the x-second timer, subsequent responses were without consequence. Thus, on type N1 $\overline{\text{T}x}$ " schedules, the minimum time between a response and the operation of the magazine was determined exclusively by the fixed-period timer and was constant at x seconds. On the other hand, on type N1 Tx" schedules the minimum time between a response and operation of the magazine depended on occurrence of responses during the cycle of the fixed-period timer. It could take, thus, any value up to a maximum of x seconds. Values of x of 10, 30, and 100 were studied for both schedule types.

Procedure

An experimental session was ordinarily 1 hour long. On schedules leading to frequent reinforcements the sessions were shortened to prevent satiation effects. Experiments were conducted 6 days per week.

The birds studied in these experiments had had extensive and varied previous experience on other schedules. All had, at some time or other, been exposed to either VI 1 min or VR 100, and all came into the experiments with a strong tendency to respond. All birds except Pigeon 7 were first exposed to a schedule intended to be N1 $\overline{\text{T}10}$ ". After about 10 days, the timer was found to have become defective, and the value of the delay was varying from a few seconds up to considerably more than 10 seconds from reinforcement to reinforcement. Figures from these sessions are not included in Table 1. Thereafter, the following sequences of presentations of schedules were followed.

Bird 7: N1 $\overline{\text{T}10}$ " — N1 $\text{T}10$ " — N1 $\text{T}30$ " — N1 $\overline{\text{T}30}$ " — N1 $\overline{\text{T}100}$ "

Bird 74: N1 $\text{T}10$ " — N1 $\text{T}100$ " — N1 $\text{T}30$ " — N1 $\overline{\text{T}10}$ " — N1 $\overline{\text{T}100}$ "

Bird 76: N1 $\text{T}100$ " — $\text{T}100$ "¹ — N1 $\text{T}10$ " — N1 $\overline{\text{T}10}$ " — N1 $\overline{\text{T}30}$ " — N1 $\text{T}30$ " — N1 $\overline{\text{T}100}$ "

Bird 152: N1 $\text{T}10$ " — N1 $\text{T}100$ " — $\text{T}100$ "¹ — N1 $\overline{\text{T}100}$ " — N1 $\overline{\text{T}10}$ "

Bird 158: N1 $\text{T}100$ " — N1 $\overline{\text{T}100}$ " — $\text{T}100$ "¹ — N1 $\overline{\text{T}10}$ "

Following a change in schedule type or parameter, at least 5 sessions and usually 10 sessions were allowed for stabilization, before collection of numbers was started for compilation of Table 1. Mean figures in Table 1 are based on 10 or more "control" days, a control day being defined as one, following stabilization, on which a drug had not been given either on that day or on the preceding day.

Observations were made on the effects on type N1 $\overline{\text{T}x}$ " schedule performances of pentobarbital and of methamphetamine at the following dose levels: pentobarbital sodium, 1.0 and 3.0 milligrams; methamphetamine hydrochloride, 0.1, 0.3, and 1.0 milligram. The

¹This schedule is described later in the paper.

Table 1
Summary of Performances on the Various Schedules
(Numbers of Responses and Reinforcements are *Per Hour*)

Pigeon No.		N1 $\overline{T10''}$	N1 $T10''$	N1 $\overline{T30''}$	N1 $T30''$	N1 $\overline{T100''}$	N1 $T100''$	$T100''$
7	Mean Resp.	142	849	102	1721	51		
	S.D. [†]	66.4	*	28	*	15.8		
	Mean Reinf.	73	155	35	78	9.6		
74	Mean Resp.	171	1053		1224	23	580	
	S.D.	154.6	*		262.5	29	219.9	
	Mean Reinf.	80	202		84	4.8	20	
76	Mean Resp.	118	1841	64	64	11	9.9	2.2
	S.D.	50.7	335.2	21.6	120.5	8.9	5.7	2.5
	Mean Reinf.	93	196	28	16	6.2	4.4	35
152	Mean Resp.	79	211			21	20	9.6
	S.D.	11.6	*			14.8	15.8	8.8
	Mean Reinf.	72	134			10	10	35
158	Mean Resp.	44				23	618	1.0
	S.D.	30.5				15.7	793.7	1.4
	Mean Reinf.	39				7	25	35
Grand Mean No. of Responses		111	988	83	1003	26	307	4.3
Grand Mean No. of Reinf.		71	172	32	59	7.5	15	35

*The numbers of responses for these birds were obtained by measurement of cumulative records. The inaccuracy of this procedure makes the estimates of variability not comparable with those for other schedules, for which responses were enumerated on digital counters.

[†]Standard deviation of number of responses.

drugs were dissolved in 0.9% sodium chloride and were injected intramuscularly 15 minutes before the start of the session. The doses stated are the total doses for the bird.

RESULTS

Responding was sustained by the type N1 $\overline{T_x''}$ schedules at all the parameter values studied. For example, Bird 7 was observed in these experiments for almost 180 experimental hours, the last 48 of which were on N1 $\overline{T100''}$. On this schedule the rates of responding in the 6th, 7th, and 8th hours were 56, 60, and 32 responses per hour, respectively; the rates in the 38th, 41st, and 46th (the last three control sessions, as defined) were 41, 52, and 76 responses per hour, respectively.

The mean rates of responding decreased as the duration of delay increased, falling from 111 responses per hour on N1 $T10''$ to 26 responses per hour on N1 $\overline{T100''}$, with the rate on N1 $\overline{T30''}$ intermediate at 83 responses per hour (Table 1). The frequency of reinforce-

ment also tended to fall with increasing delay. Two full daily sessions of Bird 7 on each of these procedures are shown in Fig. 1.

Figure 1. Representative daily sessions for Bird 7 on type $N1 \overline{T_x''}$ schedules.

A and B— $N1 \overline{T100''}$

C and D— $N1 \overline{T30''}$

E and F— $N1 \overline{T10''}$

Note the progressive increase in over-all rate as the parameter value of the type $N1 \overline{T_x''}$ schedule is reduced.

The rates of responding on these schedules were characteristically quite variable, both within individual sessions and from day to day. The average coefficient of variation of the number of responses in the daily sessions was about 0.50 for $N1 \overline{T10''}$ and about 0.75 for $N1 \overline{T100''}$. Most of the reported figures on the session-to-session variability of pigeons working on schedules providing immediate reinforcement of appropriate responses are considerably smaller than these. For example, the session-to-session coefficient of variation on VI 1 min has been found to be usually less than 0.10 (Dews, 1955). The large day-to-day variability of performances on $N1 \overline{T_x''}$ schedules makes it necessary to consider the possibility that the apparent dependence of mean rate on schedule parameter described above was simply due to sampling errors. Examination of Table 1, however, makes it clear that for each individual bird, as for the grand means, the mean rate of responding on the schedule with the longer delay was lower than the rate for the shorter delay. Seven such comparisons can be made; the probability that

the same rank order would occur by chance in all seven pairs is 1 in 128, so that the dependence of rate on schedule parameter is almost certainly a real phenomenon.

Following a change in schedule or in parameter value, the performances stabilized within a few sessions, in the sense that the over-all rate of responding, around which the day-to-day variability was occurring, showed no obvious trend (Fig. 2). In view of this, it was

Figure 2. "Stabilization" of performance. The ordinate is the mean rate of responding for five birds in the case of NI T100'' and NI T10'', and for two birds in the case of NI T30''. The abscissa is consecutive sessions starting with the first day on which the bird has been exposed to that schedule and parameter value. The horizontal lines show the mean rates of response at the various parameter values as given in Table 1 and based on control days, as defined in text, subsequent to stabilization. The figure shows that within a very few sessions the daily performance is oscillating around a mean similar to the "final stable" mean. The apparently lower day-to-day variability of performance on NI T100'' is deceptive in that the *proportionate* variability is at least as high at this value as at the other parameter values.

considered permissible to start collecting definitive figures after as few as 5 sessions, although, in general, 10 sessions were allowed for "stabilization." No claim is made that "complete stability" had been attained in the sense of complete absence of trend; it is doubtful if such "stability" has ever been proved in a behavioral situation. The most that can be said is that the day-to-day trend is small relative to the effects of the variables under study.

At any given parameter value, the rate of responding on type NI Tx'' was usually higher than that of the same bird on type NI T $\bar{x}$ ''. The mean rate was about 10 times greater at each of the parameter values (Table 1). The frequency of reinforcement also rose. There were, however, marked individual differences among the birds. All five

birds had higher rates of responding on N1 Tx'' than on N1 $\overline{\text{Tx}}''$. This is illustrated in the sessions for Pigeons 74 and 76 shown in Fig. 3. Bird 7 had a higher rate on N1 $\overline{\text{T30}}''$ but Bird 76 did not. These findings are illustrated in Fig. 4. Birds 76 and 152 had essentially the same rates of responding on N1 $\overline{\text{T100}}''$ and N1 T100'', but Birds 74 and 158 had much higher rates on the latter (23 vs. 580 and 23 vs. 618 responses per hour, respectively). Sample sessions are shown in Fig. 5.

Figure 3. Representative total daily sessions showing effect of change from type N1 $\overline{\text{Tx}}''$ schedule to type N1 T100'' schedule.

- A: Bird 74—N1 $\overline{\text{T10}}''$
- B: Bird 74—N1 T10''
- C: Bird 76—N1 $\overline{\text{T10}}''$
- D: Bird 76—N1 T10''

Note that for each of the pigeons, transfer from type N1 $\overline{\text{Tx}}''$ to type N1 Tx'' schedule led to a considerable increase in over-all rate of responding.

The mean rate of 26 responses per hour on N1 $\overline{\text{T100}}''$ is so low that the question arises as to whether the response-requirement contingency was having any sustaining effect on the responding. To investigate this, three of the birds were studied on a procedure in which the magazine operated at 100-second intervals, irrespective of the behavior of the bird. This schedule is designated T100'' in Table 1 and Fig. 6. Ten sessions were run. Under this procedure the rate of responding was much lower than on N1 $\overline{\text{T100}}''$: 2.2² as compared with 11, 9.6² as compared with 21, and 1.0² as compared with 23 responses per

²Mean for last 5 of 10 sessions.

hour for the three birds, in spite of the fact that the frequency of reinforcement was 35 reinforcements per hour on $T100''$ as compared with a mean of 7.5 reinforcements per hour on $N1 \overline{T100''}$. It seems clear that the response requirement of $N1 \overline{T100''}$ had a definite effect in enhancing the frequency of responding.

Determinations of parts of the dose-effect curves for pentobarbital and for methamphetamine were made on two birds (74 and 76) on $N1 \overline{T10''}$, on one bird (7) on

Figure 4. Representative total daily sessions showing effect of change from type $N1 \overline{T_x''}$ schedule to type $N1 T_x''$ schedule.

- A: Bird 7 — $N1 \overline{T30''}$
- B: Bird 7 — $N1 T30''$
- C: Bird 76 — $N1 \overline{T30''}$
- D: Bird 76 — $N1 T30''$

The change in schedule type led to an increase in rate of responding by Bird 7 but not by Bird 76.

$N1 \overline{T30''}$, and on two birds (74 and 152) on $N1 \overline{T100''}$. In general, doses of both pentobarbital and methamphetamine were found which tended to increase the rate of responding (Fig. 7). Most interesting was an interaction between schedule parameter and drug. The

longer the delay and the lower the consequent control³ rate of responding, the greater was the tendency of optimum doses of methamphetamine to cause an increase in rate of responding. The reverse situation was obtained with pentobarbital. The shorter the delay of reinforcement, and thus the higher the control rate of responding, the greater was the effect of the optimum doses of pentobarbital in increasing the rate of responding. These relationships are illustrated for selected doses of the two drugs in Fig. 8, and sample sessions are shown in Fig. 9 and 10.

DISCUSSION

Clearly, behavior in pigeons can be maintained under conditions of delay between response and presentation of reinforcement. This is shown by the long periods over which responding was continued under these contingencies and by the quick fall to new low rates when the response dependency of reinforcement was removed (T100").

The maximum delay at which behavior is maintained was not determined, but it is clearly in excess of 100 seconds, since at a 100-second delay the rate of responding was several times higher on the average than when responses were without programmed consequence. It should be noted, however, that the effect of the reinforcer is being measured here in terms of its ability to *maintain* previously well-conditioned behavior. The effects of delay of reinforcement on initial acquisition have not been studied in this series of experiments.

The effect of the presentations of food—the reinforcements—on the behavior of pecking the key, as measured by the rate of pecking, decreases as the time interval between the peck and the reinforcement increases. In other words, retroactive enhancement of the likelihood

Figure 5. Representative total daily sessions showing effect of change from type N1 $\overline{T}x''$ schedule to type N1 $\overline{T}x''$ schedule.

- A: Bird 152—N1 $\overline{T}100''$
- B: Bird 152—N1 $\overline{T}100''$
- C: Bird 158—N1 $\overline{T}100''$
- D: Bird 158—N1 $\overline{T}100''$

The change in schedule type led to an increase in rate of responding by Bird 158 but not by Bird 152.

³That is, rate on control days, as defined.

Figure 6. Representative total daily sessions showing effect of change from N1 $\overline{T100''}$ to procedure in which food magazine operated every 100 seconds irrespective of behavior of bird ($\overline{T100''}$).

A: Bird 76 — N1 $\overline{T100''}$

B: Bird 76 — $\overline{T100''}$

C: Bird 158 — N1 $\overline{T100''}$

D: Bird 158 — $\overline{T100''}$

Note almost complete cessation of responding by both birds when food-magazine operation was made independent of responding.

of future occurrences of the response decreases as the time interval between response and reinforcement is lengthened. The curve of control values shown in Fig. 8 cannot be taken as a direct estimate of the true form of the relationship between the reinforcing power of a reinforcement and its temporal contiguity to a response. This is because the type N1 $\overline{T_x''}$ schedules have inherent in them a "differential reinforcement of low rates" contingency, in that, on N1 $\overline{T_x''}$, inter-response times of less than x second lead to postponement of reinforcement, and only inter-response times as great as x seconds permit reinforcement. By analogy to conventional DRL schedules, this contingency would be expected to depress the rate of responding, so, in general, the rates engendered by type N1 $\overline{T_x''}$ schedules would be expected to be lower than those which would have developed if the rate-elevating effect of even the *delayed* reinforcement had been unopposed.

No specified behavior is necessary during the time between the response of pecking the key and occurrence of the reinforcing stimulus, except that on type N1 $\overline{T_x''}$ the key must not be operated. Presumably, some behavior occurring during this delay will be fortuitously reinforced (Skinner, 1948). Such behavior is characteristically variable; and since it may compete with key-pecking behavior, it will contribute to the observed variability in frequency of key pecking. The difference in rate on N1 $\overline{T_x''}$ and on N1 T_x'' at the same value of x is clearly dependent on circumstances of adventitious reinforcement. In order for the change in schedule to have a consequence for the pigeon, responses must oc-

cur during the delay time. Such responses are closer to the time of presentation of the reinforcing stimulus; so the delay of reinforcement of the recorded responses will be effectively reduced, and this, as shown in this paper, will tend to increase the rate. In addition, the $N1 \overline{T}x''$ schedules do not differentially reinforce low rates of responding as do the $N1 \overline{T}x'$ schedules, since the former permit any inter-response time to be concluded by reinforcement. The removal of the DRL contingency would also be expected to permit the rate to rise on $N1 \overline{T}x''$ schedules as compared with corresponding $N1 \overline{T}x'$ schedules.

The range of time intervals between response and reinforcement studied in these experiments covers the frequently used RS intervals of operant-avoidance procedures; in these procedures, as in the present experiments, the external consequences of the responses are

Figure 7. Partial dose-effect curves for pentobarbital and methamphetamine on $N1 \overline{T}x''$ schedule performances. The value of x appropriate to each panel is shown in top right-hand corner.

Abscissa: dose. Ordinate: ratio of mean rate of responding in sessions after drug was given ("output ratio"). Horizontal dotted lines show range of ± 2 estimated standard errors around mean control values; the probabilities of the mean values of output ratios seen following 0.1 milligram and 0.3 milligram of methamphetamine on $N1 \overline{T}100''$ and following 3.0 milligrams of pentobarbital on $N1 \overline{T}10''$ occurring as a result of sampling errors only are very small. Note the great change in position of the curves as the schedule-parameter value is changed.

inevitably delayed. Preferred intervals between CS and US in Pavlovian conditioning are usually shorter. Increasing the RS interval in avoidance procedures or the CS-US interval in Pavlovian conditioning beyond, at most, a very few minutes leads to extinction. On the other hand, in experiments with positively reinforced operants, the time between a response and the next occurrence of the reinforcing stimuli may be many minutes or even hours. For example, typical fixed-interval behavior has been maintained in pigeons with fixed intervals

up to 150 minutes (Dews, unpublished observations); under these conditions, substantial rates of responding are maintained at times in the interval 1–2 hours before possible reinforcement. The salient difference between this situation and the others referred to earlier in this paragraph is that with fixed-interval schedules, and most other schedules of positive reinforcement, the response-to-be-reinforced is followed essentially instantaneously by the reinforcing stimuli, whereas with the schedules of this paper, operant avoidance, and Pavlovian conditioning, the environmental reinforcing stimuli supervene only after some delay. Ordinary schedules of positive reinforcement thus retain the precision of control characteris-

Figure 8. Re-plot of some data of Table 1 and Fig. 6 to illustrate dependency of drug effect on schedule parameter. Note that the rate of responding following 0.3 milligram of methamphetamine was actually greater when the type N1 $\overline{T}x''$ schedule parameter was 100 seconds than when it was 10 seconds despite the converse trend of the controls. Following pentobarbital, the increase in rate was greater for the parameter values giving the higher control rates.

tic of immediate reinforcement, even though they permit the repeated occurrence of the recorded response during the presentation of an S^D and can thereby occasion large outputs of behavior over prolonged periods of time.

The findings reported are of some practical interest in connection with the commonly

used practice of imposing a short "changeover delay" when it is desired to eliminate the effects on rate of responding in one (usually S^A) component of a multiple schedule of the reinforcing effects of the stimulus change. Under conditions of "changeover delay," it is arranged that the stimuli will not change within x seconds of a response. It is often assumed that values of x as short as 5 seconds are sufficient to completely eliminate the reinforcing effects of the change of stimuli on the tendency to respond. The present work shows that even 100 seconds is not necessarily long enough for this purpose.

Drug Effects

There is now quite general recognition of the importance of the type of schedule of reinforcement under which an animal is working in determining the behavioral effect of a drug. The present experiments show clearly that not only the nature of the schedule but also its parameter values have large effects. For both of the drugs studied, the effect on behavior maintained by a single type of schedule, $N1 \overline{T}x''$, varied several-fold depending on the value of x . Not only does the parameter value modify the effects of the drugs, but it does so differentially in the sense that the functional dependence of drug effect on parameter value for pentobarbital is quite different from that for methamphetamine. The nature of this functional dependence is evidently a matter of considerable pharmacological interest.

Figure 9. Representative total daily sessions showing effects of drugs on performance of Bird 74 on $N1 \overline{T}10''$ schedule.

- A—Control
- B—Following 0.3 milligram of methamphetamine
- C—Following 3.0 milligrams of pentobarbital

Pentobarbital caused a considerable increase both in over-all rate and in intrasession variability of rate of responding. The effect of the methamphetamine is much less obvious at this parameter value.

Figure 10. Representative total daily sessions showing effect of drugs on performance of Bird 152 on N1 T100 schedule.

- A—Control
- B—Following 3.0 milligrams of pentobarbital
- C—Following 0.3 milligram of methamphetamine

Responding almost ceased after the pentobarbital, while the methamphetamine led to a period of sustained responding at a rate sufficiently high to preclude the possibility of occurrences of reinforcements.

It has previously been suggested that an important determinant of the effects of amphetamines is the control rate of responding, in that the lower the control rate, the greater the proportionate increase to be expected following optimum doses of amphetamine (Dews, 1958). The results of the present study are in complete agreement with this suggestion. The increase in rate following 0.3 milligram of methamphetamine was only about 10% when the control rate was about 110 per hour, but was some 830% when the control rate was 26 per hour (Fig. 7). As previously found, for some time after the administration of 1.0 milligram of methamphetamine, all but the most strongly maintained behavior tends to be reduced.

Pentobarbital, on the other hand, shows increasing rate-enhancing action with increase in control rate of responding. One possible interpretation, which is in agreement with traditional views of the behavioral effects of the drug, is as follows. The frequency of reinforcement on N1 T100 was on the average greater than 1 per minute. Such a high frequency might be expected to engender a high tendency to respond. The nature of the schedule, however, "requires" that the rate of responding be "suppressed" to a relatively low level. On N1 T100 the rate of occurrence of presentations of the reinforcing stimuli was less than 0.15 per minute, so the amount of "suppression" necessary to con-

form to the schedule might have been less. If pentobarbital were to "attenuate the suppression" or "release the inhibition," then a greater effect would be seen on N1 T10" performance than on N1 T100" performance, as observed. While this interpretation is *ad hoc*, and many other accounts are compatible with the present data, the above view has the advantage of being in accordance with the impressions gained from clinical experience with barbiturates and drugs with similar pharmacological effects.

SUMMARY

The performance of pigeons has been studied on schedules on which reinforcing stimuli were presented only when a response was followed by some specified "delay" period without a response. Even when this period was as long as 100 seconds, responding was maintained at rates in excess of those resulting from presentation of the reinforcing stimuli at 100-second intervals entirely noncontingent on responding.

Waiting periods of 30 seconds and of 10 seconds between response and reinforcing stimuli have also been studied; the over-all rate of responding was higher with the shorter waiting periods.

The effects of pentobarbital and of methamphetamine were found to be differentially modified by change in the waiting period.

The rate of responding tended to be higher on schedules similar in all respects except that responses during the "delay" period did not postpone reinforcement.

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