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Baseline Response Rate and the Effect of a Stimulus which Precedes Response-Independent Reinforcement

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BASELINE RESPONSE RATE AND THE EFFECT OF A
STIMULUS WHICH PRECEDES RESPONSE-INDEPENDENT REINFORCEMENT

by

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BASELINE RESPONSE RATE AND THE EFFECT OF A STIMULUS
WHICH PRECEDES RESPONSE-INDEPENDENT REINFORCEMENT

William M. Arnold, M. A.

Western Michigan University, 1970

The relationship between baseline response rate and the effect of presenting a stimulus followed by response-independent reinforcement on baseline response rate was investigated in this study. Six pigeons were divided into two equal groups, one of which was conditioned to key peck on a VI-DRH schedule of food reinforcement, the other on a VI-DRL schedule of food reinforcement. Once responding had stabilized, a tone was introduced seven times during each session followed by a response-independent food reinforcement. The results indicated no change in the response rate of the VI-DRH group during the tone, and acceleration of responding during the tone for the VI-DRL group.

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William M. Arnold

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Superimposing a signaled response-independent reinforcement on an operant baseline has produced both an increase (Herrnstein and Morse, 1957; Brady, 1961) and a decrease in the response rate (Azrin and Hake, 1969; Pliskoff, 1961, 1963), during the signal. In a study by Herrnstein and Morse (1957), for example, a pigeon's key pecking behavior was maintained on a differential reinforcement of low rate (DRL-5 minutes) schedule for food reinforcement. This schedule requires the subject to emit consecutive responses with a minimum interresponse time of five minutes in order to obtain reinforcement. After 21 days of conditioning, a two minute stimulus was introduced, 25 to 30 times during each session, and a response-independent food reinforcement was presented one minute after the onset of the stimulus. The results of this study indicated both an increase and a decrease in response rate during the stimulus, although the predominant effect was an increase in rate. Herrnstein and Morse proposed that the maintenance and acceleration of responding during the stimulus may have been a function of an adventitious reinforcement contingency. Although this contingency may not have been the cause of the initial increase, the increased response rate certainly would have increased the probability of an accidental correlation between responses and the presentation of a reinforcer.

Brady (1961) also found acceleration of responding during a stimulus which preceded a response-independent reinforcement. In this study rats were conditioned to lever press for water on a variable-interval two minute schedule of reinforcement. A five minute stimulus

was presented ten times during each session and terminated with the delivery of a 0.5 second intracranial electrical stimulation (ICS). Although the response-independent reinforcer used in this study differs qualitatively from the food used in the Herrnstein and Morse study (1957), two points of similarity should be considered. First, both studies had relatively low baseline rates of responding, and secondly, in both studies the stimulus followed by response-independent reinforcement brought acceleration of responding during the stimulus.

Response suppression during a stimulus which preceded a response-independent reinforcement was demonstrated by Azrin and Hake (1969). In that study, the rat's lever pressing behavior was maintained on a variable interval one minute schedule of reinforcement for either food or water. The response-independent reinforcer, either food, water, or intracranial stimulation (ICS), was presented contiguously with the offset of a ten second stimulus. Approximately 20 stimulus presentations occurred during each two hour session. The results of this study indicated a decrease in response rate during the stimulus, except when water was used for both the baseline and response-independent reinforcer. In that case an increase in response rate was observed. Azrin and Hake suggested that the reduction in responding during the signal involved autonomic changes, perhaps reflecting some "underlying emotional state of heightened preparedness" (Azrin and Hake, 1969) which interfered with normal responding. The acceleration in responding of the water-water group, however, was interpreted as reflecting the effect of adventitious reinforcement.

Another technique for assessing the effect of a signaled response independent reinforcement involves a signaled change in the density of reinforcement. Pliskoff (1961, 1963) reinforced pigeons for pecking a white key on a variable-interval two minute (VI-2) schedule of food reinforcement. At the end of ten minutes, the key color was changed to either red or green and the schedule of reinforcement was changed to a VI-15 minute or VI-0.5 minute for another ten minutes. The key color was then returned to the original white and the VI-2 minute was reinstated. A warning stimulus was then introduced one minute prior to the change from one schedule to the other. The results showed an increase in the response rate during the stimulus which signaled the subsequent change to the VI-15 minute schedule, a schedule with less reinforcement density, and a decrease in the response rate during the stimulus which signaled the subsequent change to the VI-0.5 minute schedule, a schedule with greater reinforcement density. Since both response acceleration and response suppression have been obtained during the stimulus other than a simple increase in the reinforcement density, it would appear that variables or adventitious reinforcement could account for these data. One such variable, which might account for the differences in results could be the baseline response rate. The results of Herrnstein and Morse (1957) and Brady (1961) showed acceleration during the stimulation on low response rate baselines. The results of Pliskoff (1961, 1963) and Azrin and Hake (1969) showed suppression during the stimulus on high response rate baselines.

Baseline response rate has been shown to be a major factor influencing the effect of a signaled response independent shock in several studies conducted by Blackman (1966, 1967, 1968a, 1968b). In one of these studies (Blackman, 1968b) a variable-interval schedule of reinforcement was combined with differential reinforcement of specific response rates. By making reinforcement available on a VI and then requiring consecutive responses with a specified inter-response time (IRT), both low and high response rates were obtained with equal reinforcement frequency. When a signaled response-independent shock was superimposed on these baselines, severe suppression was obtained on the high response rate baseline, but only partial suppression was obtained on the low response rate baseline.

The purpose of the present study was to investigate the effect of a signaled response-independent reinforcement on high and low response rate baselines. Reinforcement frequency on the baseline schedules was held constant by the use of a variable interval-100 second schedule of food availability, and response rates were controlled by the use of differential interresponse time requirements.

METHOD

Subject

The subjects were six white King pigeons with a history of visual, but not auditory, discrimination training. The subjects were housed individually and maintained at 70% of free-feeding weight with Maple peas. Grit and water were available only in the home cage. Reinforcement consisted of a mixture of 40% vetch,

50% kaffer corn, and 10% hemp seed. Only five subjects are reported in the results since VI-DRH Subject 3 never met criterion during the baseline period.

Apparatus

The intelligence panel consisted of a single white illuminated key, 3/4 inches in diameter, mounted eight inches above the floor. The key required approximately seven grams of pressure to register a response. The grain reinforcement was made available for four seconds through a 2x2 inch opening, four inches below the key. The intelligence panel was mounted in a sound attenuated chamber which was provided with forced air ventilation, but no houselight.

The pre-reinforcement stimulus was a 2800 Hz tone presented by a Mallory model SC-628 Sonalert with 4400 ohms resistance in series, which was mounted on the back of the intelligence panel.

The programming and recording of events were accomplished with BRS-Foringer 200 series modules, and appropriate clocks and film drivers. The data were recorded from a Gerbrands Model C3-SHS cumulative recorder and electrical impulse centers.

Procedure

The subjects were divided into two groups and reinforced for key pecking on a variable-interval schedule of food reinforcement combined with a differential reinforcement of specific response rates. Reinforcement was made available on a VI-100 seconds, the intervals of which were determined by the formula (Catania and Reynolds, 1968):

$$T_n = n \frac{F}{(N+I)-i}$$

i=1

Once reinforcement was made available, it remained available until either the subject emitted a specified number of responses with a specified interresponse time (IRT) and the reinforcement was obtained, or, until the next reinforcement was made available, at which time the first reinforcement was lost.

The first group, VI-DRH, was required to emit three consecutive responses with an IRT of less than 0.3 seconds before an available reinforcement could be obtained. This procedure, (VI-DRH) was designed to generate response rates of greater than 65 responses per minute.

The second group, VI-DRL, was required to emit two consecutive responses with an IRT of greater than five seconds before an available reinforcement could be obtained. This procedure (VI-DRL) was designed to generate response rates of less than 12 responses per minute.

Each subject was exposed to the experimental procedures on a daily basis until 50 reinforcements had been obtained. When the mean response rate per session for a subject stabilized, i.e. a range of ± 8 responses per minute over seven consecutive sessions, the stimulus, a 14 second tone, was presented seven times to the subject during the following session to observe any possible effects the stimulus itself may have had upon the subject's response rate. No stimulus was presented during the following session, the ninth and last day of baseline. The next session began the experimental phase, during which

the stimulus was presented seven times per session at varying intervals averaging 13 minutes, followed each time by a response-independent presentation of seven seconds of food.

Note that the duration of the reinforcement following the stimulus was more than double that of the reinforcement received on the VI schedule. Also, note that for each stimulus presentation the probability was approximately equal that a response-contingent reinforcement would be made available during: 1) the stimulus; 2) a one minute pre-stimulus period; or 3) a one minute post-stimulus period.

The total number of responses and reinforcements, the number of responses and reinforcements in a one minute period preceding each stimulus onset (pre-stimulus), and the number of responses and reinforcements during the stimulus were recorded. The effect of the stimulus which preceded the response-independent reinforcement was determined by an inflection ratio described by Brady (1955). This ratio is expressed by the formula $\frac{B-A}{A}$, where A is the mean response rate for one minute pre-stimulus periods, and B is the mean response rate during the stimulus presentations. A ratio of 0 indicated no effect, a ratio of -1 indicated total suppression, and a ratio of +1 was arbitrarily chosen to indicate acceleration.

RESULTS

The response rates for all the three subjects in the VI-DRL group and for two Subjects in the VI-DRH group were sufficiently stable to be exposed to the experimental manipulations. The mean response rate

TABLE I

The Mean Response Rate and Reinforcement Frequency for Each Subject For All Sessions in the Baseline and in the Experimental Phase

SUBJECTS	BASELINE		EXPERIMENTAL	
	Response Rate	Reinforcement Frequency	Response Rate	Reinforcement Frequency
VI-DRL 1	13.7 13.7	0.60	16.3	0.61
VI-DRL 2	11.9	0.58	16.5	0.61
VI-DRL 3	16.0	0.52	14.8	0.60
VI-DRH 1	81.2	0.66	93.4	0.71
VI-DRH 2	77.4	0.67	89.1	0.65

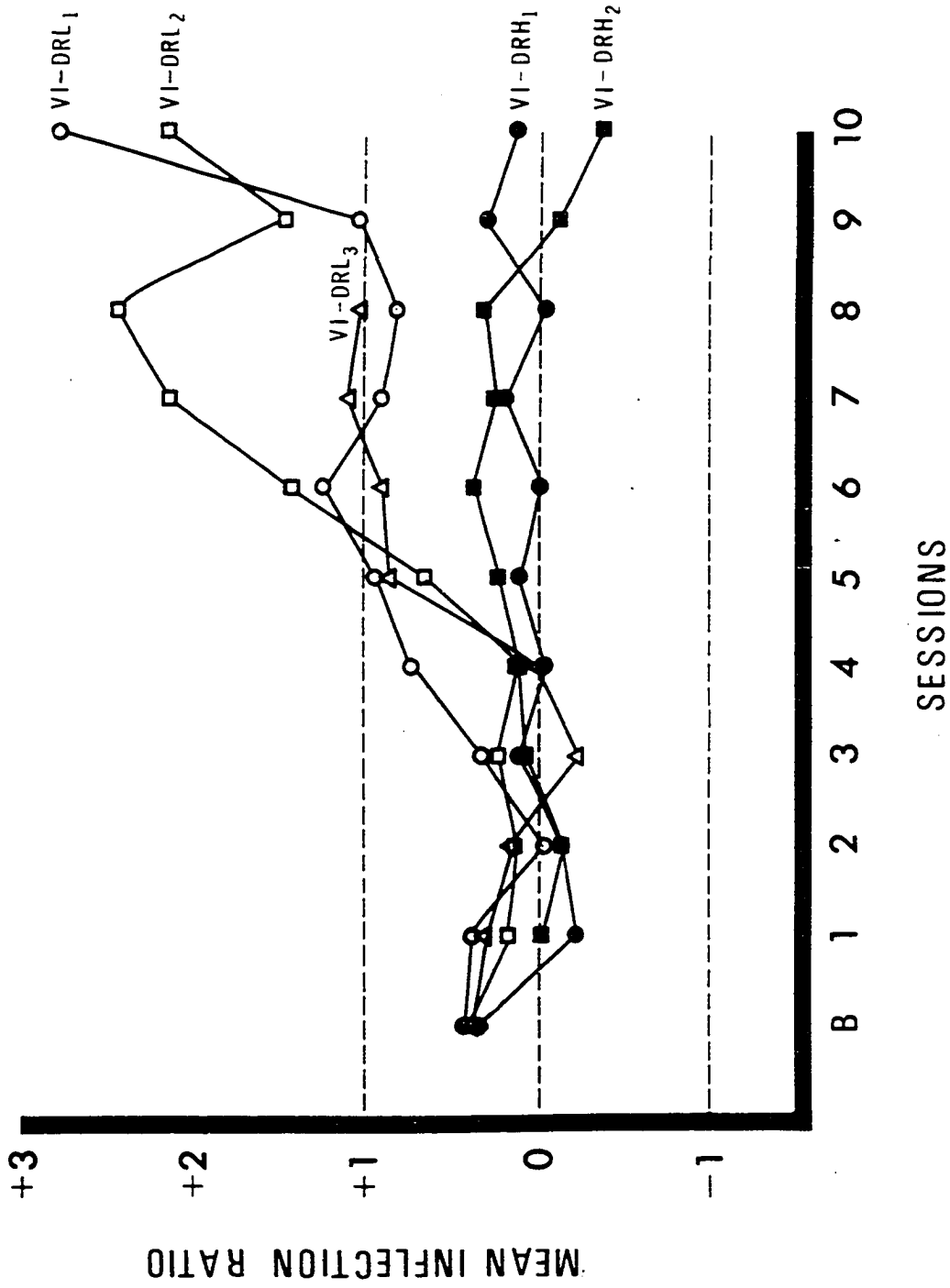
per minute for all sessions in the baseline and in the experimental phase for each of the five subjects is shown in Table 1. The mean reinforcement frequency per minute for all sessions in the baseline and in the experimental phase for each of the five subjects is also shown in Table 1. Since the response rate for Subject 3 of the VI-DRH group did not stabilize during baseline, this subject was removed from the experiment.

As indicated in Table 1, the mean response rate for the VI-DRL subjects was relatively low, averaging 13.7, 11.9, and 16.0 responses per minute during baseline and 16.3, 16.5, and 14.8 responses per minute during the experimental phase. In contrast, the mean response rate for the VI-DRH subjects was relatively high, averaging 81.2 and 77.4 responses per minute during baseline and 93.4 and 89.1 responses per minute during the experimental phase.

The mean reinforcement frequency for each subject during each phase is included in Table 1. Since it was possible for the subjects to miss some of the reinforcements made available, i.e. if the specific IRT requirement was not met before the next reinforcement was made available. As indicated in this table, very little within the subject or between subject differences in reinforcement frequency occurred.

The mean inflection ratio per session for each subject is shown in Figure 1. The baseline session (B) in this figure refers to the session during which only the stimulus was presented. Session 1 represents the first experimental session, during which the stimulus was followed by the response-independent reinforcement. The mean

Fig. 1. Mean inflection ratio for each subject as a function of the number of session. (Note that due to a procedural mistake, VI-DRH Subject 2 did not receive a baseline session with stimulus alone presentations. Therefore, inflection ratios for VI-DRH Subject 2 begin with Session 1).



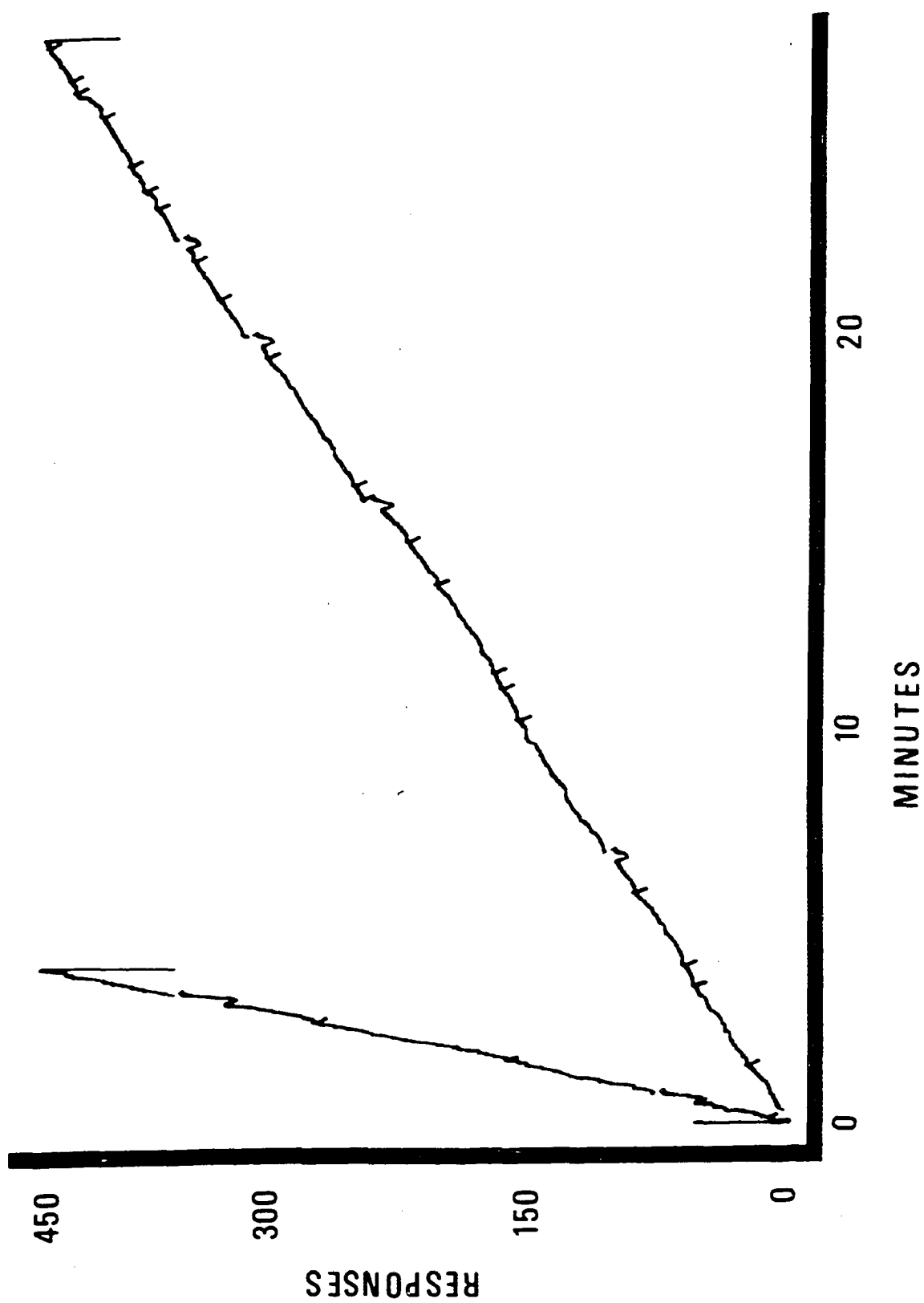
inflection ratios of the VI-DRL subjects, as shown in Figure 1, increased from 0.43 and 0.40 in baseline to 2.80 and 2.20, respectively, on Session 10 indicating severe acceleration. Since VI-DRL Subject 3 took longer to stabilize baseline response rate, only eight experimental sessions were conducted before the experiment was terminated. The inflection ratio for VI-DRL Subject 3, however, still reveals an increase similar to that of the other two VI-DRL Subjects. Since inflection ratios of 1.0 or greater were chosen to indicate acceleration of responding during stimulus, it may be concluded that all subjects in the VI-DRL group showed acceleration at the time the experiment was terminated.

The mean inflection ratios of the VI-DRH subjects, are also shown in Figure 1. As indicated in Figure 1, these ratios fluctuated around 0.0, and at no time did they deviate more than 0.37 in either direction from 0.0. Thus, it may be concluded that the stimulus did not have any appreciable effect upon the response rates of the VI-DRH subjects.

Examples of the baseline response rates and the response rates during the stimulus are shown in the two cumulative records presented in Figure 2. Reinforcements are noted by short downward slash marks and the stimulus is noted by a depression of the pen for the duration of the stimulus and response-independent reinforcement. The response rates shown in this figure indicate that both groups had stable response rates before and after the stimulus presentation, while during the stimulus only the response rate of the VI-DRL group changed. Also it may be seen that the change in the response rate of the VI-DRL

group during the stimulus was an increase over the pre-stimulus response rate.

Fig. 2. Examples of the baseline response rates and the response rates during the stimulus, as shown in the cumulative records.



DISCUSSION

A stimulus followed by response-independent reinforcement, as indicated by the results of the present study, differentially effects high and low baseline response rates. The present results indicate that if baseline response rate is low, the response rate during the stimulus increases, while, if the baseline response rate is high, the response rate during the stimulus shows little change.

In comparing the results of the present study to the findings of Herrnstein and Morse (1957) and Brady (1961), the present results support the earlier findings of acceleration of responding during the stimulus for subjects with low baseline response rates.

Although the response rate of the subjects with high baseline response rates did not accelerate during the stimulus, the present findings indicate no reduction in responding during the stimulus. Thus, these results do not support the findings of earlier studies by Azrin and Hake (1969) or Pliskoff (1961, 1963), since each of these earlier studies did find a reduction in response rate during a stimulus which preceded response-independent reinforcement (Azrin and Hake, 1969) and high reinforcement density (Pliskoff, 1961, 1963).

In analyzing the present results, three possible interpretations are available. The first interpretation states that by accidental contiguity between a response and the response-independent reinforcement, the probability of responding during the stimulus is increased.

In addition, the more the response rate increased during the stimulus, the higher the probability of further adventitious reinforcement. This was used by Herrnstein and Morse (1957), Brady (1961) and Azrin and Hake (1969) to explain the acceleration of responding during the stimulus found in their studies. An objection to this interpretation however, might be that subjects with a high frequency of key pecking, the VI-DRH group, should have a higher probability of receiving adventitious reinforcement for key pecking than subjects with a low frequency of key pecking, the VI-DRL group. If adventitious reinforcement was an effective variable in the present study, then this effect should have been most obvious in the VI-DRH group. These subjects, however, with the highest frequency of key pecking showed the least effect of adventitious reinforcement.

A second possible interpretation, introduced by Azrin and Hake (1969) suggests that some underlying emotional state of heightened preparedness causes the animal to decrease responding during the stimulus. Although this is a possibility, this interpretation would not explain the differential effects on the high and low rate baselines as found in the present study.

The third possible interpretation is that the effect of the stimulus was to decrease the rate of certain responses within a response chain; the total response chain comprising the key peck response. This interpretation appears to be consistent with the results of all of the studies under consideration. In the Azrin and Hake study (1969) and the Pliskoff studies (1961, 1963) the effect may have been to decrease the rate of all responses in the chain

during the stimulus. In the Herrnstein and Morse (1957) the Brady study (1961) and the present study, however, the effect may have been to decrease the rate of only some of the responses which compete with key pecking and which comprise a chain of timing behaviors developed through superstitious conditioning. Here again, however, no data were collected on the occurrence of competing behaviors in the VI-DRL subjects and, therefore, the validity of this interpretation remains to be investigated.

REFERENCES

- Azrin, N. H., and Hake, D. F. Positive conditioned suppression: conditioned suppression using positive reinforcers as the unconditioned stimuli. Journal of the Experimental Analysis of Behavior, 1969, 12, 167-173.
- Blackman, Derek. Response rate and conditioned suppression. Psychological Reports, 1966, 19, 687-693.
- Blackman, Derek. Effects of response pacing on conditioned suppression. Quarterly Journal of Experimental Psychology, 1967, 19, 170-174.
- Blackman, Derek. Conditioned suppression or facilitation as a function of the behavioral baseline. Journal of the Experimental Analysis of Behavior, 1968, 11, 53-61.
- Blackman, Derek. Response rate, reinforcement frequency, and conditioned suppression. Journal of the Experimental Analysis of Behavior, 1968, 11, 503-516.
- Brady, Joseph V. Motivational-emotional factors and intracranial self-stimulation. In D. E. Shear (Ed.) Electrical Stimulation of the Brain. Austin: University of Texas Press, 1961, 413-430.
- Brady, Joseph V. Extinction of a conditioned "fear" response as a function of reinforcement schedules for competing behavior. The Journal of Psychology, 1955, 40, 25-34.
- Catania, A. Charles and Reynolds, G. S. A quantitative analysis of the responding maintained by interval schedules of reinforcement. Journal of the Experimental Analysis of Behavior, 1968, 11, 327-383.
- Herrnstein, R. J., and Morse, W. H. Some effects of response-independent positive reinforcement on maintained operant behavior. Journal of Comparative and Physiological Psychology, 1957, 50, 461-467.
- Pliskoff, Stanley. Rate-change effects during a pre-schedule-change stimulus. Journal of the Experimental Analysis of Behavior, 1961, 4, 383-386.
- Pliskoff, Stanley S. Rate-change effects with equal potential reinforcements during the "warning" stimulus. Journal of the Experimental Analysis of Behavior, 1963, 6, 557-562.

APPENDIX I

Order of Intervals of Reinforcement Availability

174 sec.	22	282	56
50	198	134	4
154	98	80	108
383	90	122	44
64	30	8	26
18	38	32	12
			72
			232

Order of Intervals of CS Onset

600

51

271

568

390

181

110