

CONDITIONED SUPPRESSION AND VARIABLE RATIO REINFORCEMENT¹

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Conditioned suppression is a decrease in response rate during a relatively short duration stimulus that terminates independently of the animal's behavior and coincidentally with a brief unavoidable shock. The degree of conditioned suppression was measured for each of three birds on three variable ratio schedules; that is, the number of responses required for food reinforcement was varied around a mean of 50, 100, or 200. The results indicated a slight and possibly negligible decrease in the degree of suppression as the mean number of responses required on the schedule was increased from 50, to 100, and 200. In general, it was found that all of the variable ratio schedules tested were quite insensitive to the conditioned suppression procedure, although almost complete suppression was obtained on a few occasions. Since the reinforcement was contingent upon the emission of responses, the birds typically displayed a high rate of response during the pre-shock stimulus on all schedules. In addition, the rate during the pre-shock stimulus often changed abruptly independent of the presentation of a reinforcement. As a result of the high rate of response and the abrupt changes in rate, the degree of suppression from trial to trial was quite variable. A clear analysis of an experimental variable on this baseline is thus difficult.

The behavioral effect variously known as conditioned suppression, conditioned "anxiety", or the conditioned emotional response (CER) was first defined experimentally by Estes and Skinner (1941). They demonstrated that responding maintained by appetitive reinforcement decreases in rate during a stimulus that is terminated independently of behavior and coincidentally with an unavoidable shock. Recent studies of the Estes-Skinner conditioned suppression procedure indicate that the degree of conditioned suppression is not necessarily governed exclusively by such factors as the shock intensity and its temporal relationship to the pre-shock stimulus. The magnitude of suppression is influenced by other variables associated with the appetitive reinforcement used to maintain the baseline behavior. On the basis of the results of a number of studies (Stein, Sidman, and Brady, 1958; Brady, 1955; Carlton and Didamo, 1960; Lyon, 1963; Lyon, 1964), recent authors (Lyon, 1964; Carlton and Didamo, 1960) have suggested that when an Estes-Skinner conditioned suppression procedure is superimposed on a variable schedule of

reinforcement, the degree of conditioned suppression will be determined by the frequency of reinforcement. This interpretation has been supported for variable interval schedules (Lyon, 1963), but has not been demonstrated on variable ratio schedules. The present study was designed to measure the degree of conditioned suppression on three variable ratio schedules of reinforcement.

METHOD

Subjects

Three white Carneaux barren hen pigeons were maintained within 15 g of 75% of their free-feeding weight. Maple peas were given when necessary to maintain the deprivation rhythm, and water was available at all times. The identification number of each bird corresponds to its 75% body weight.

Apparatus

A 13 by 13 by 15.5 in. response chamber was constructed in a sound-attenuated enclosure (Gill, Fry, and Kelleher, 1962). The response key was a .75 in. back-lighted translucent disk mounted 8 in. from the floor in the center of the wall. The key required approximately 6-8 g pressure to operate. On the same wall located 2½ in. above the floor was a 2 by 2.5 in. open-

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ing through which a grain hopper containing 50% Kaffir, 40% vetch and 10% hempseed could be made available. Reinforcement was a 3.5 sec presentation of this hopper. During reinforcement a dim light was presented above the reinforcement hopper and the two 6 w house lights were extinguished.

A common door buzzer was used as the pre-shock stimulus (CS). The metal cover of the buzzer was removed and the device was mounted on a piece of sponge rubber to decrease sound intensity. The intensity of the buzzer under normal experimental conditions was 74 db, as measured by a type 759 sound level meter manufactured by General Radio. The device used to deliver shock to wing bands attached to the birds has been described by Hoffman and Fleshler (1959). An ac shock source was programmed through a 20 msec pulse former to provide the aversive stimulus.

The procedure was programmed by appropriate electro-mechanical timers, stepping switches, and relay circuitry. The data were recorded by electrical impulse counters and a Gerbrands recorder.

Procedure

The key pecking behavior was first established on a variable ratio schedule of reinforcement (VR 25); an Estes-Skinner conditioned suppression procedure was then superimposed on this baseline. The onset of the 1 min CS was programmed at varied intervals, and terminated with delivery of an unavoidable shock. The interval between stimuli was varied according to the following schedule: 5, 4, 7, 5, 3, and 6 min. In order to maintain the same schedule of CS presentations for the three VR schedules, and since each session was terminated after the subject received 50 food reinforcements, the number of CS-shock trials was allowed to vary for the three schedules. With very few exceptions, there were four CS-shock trials per session during the VR 50, 8 to 10 per session during the VR 100, and 14 to 16 per session for the VR 200.

During this stage, it was necessary gradually to adjust the shock up to 90 v, and to change the VR schedule, in order to obtain stable suppression behavior. After suppression was stable, the degree of suppression was measured on a VR 50 with ratio values of 21, 49, 7, 98, 14, 49, 21, 63, 7, 98, 42, 28, 77, 7, 42, 84, 70, 91, 48; a VR 100 with ratio values of 201, 14, 77, 126,

7, 98, 105, 168, 28, 91, 217, 7, 119, 154, 98, 133, 21, 175, 105, 56; and a VR 200 with ratio values of 70, 349, 14, 399, 301, 162, 42, 287, 133, 227, 7, 409. The degree of suppression was measured on each schedule for a minimum of seven sessions, and behavior was considered stable if suppression ratios for three of the last five sessions did not deviate by more than 10 units. The sequence and number of sessions for each schedule are presented in Table 1 for the three birds. The two measurements of VR 200 for bird 385 were separated by three sessions of VR 100.

Table 1
The Sequence and Number of Sessions for the VR Schedule Presentations

<i>Subject</i>	<i>VR schedule</i>	<i>No. of sessions</i>
300	200	8
	50	10
	100	10
	200	17
358	100	7
	200	7
	200	9
	100	14
	50	14
322	100	9
	200	11
	50	9
	100	10

RESULTS

The results were analyzed in terms of the mean rate of response during the CS divided by the mean rate in the absence of the CS for each session. This measure is defined as the suppression ratio (Libby, 1951). Complete suppression is indicated when the ratio is at zero. The median suppression ratios for the last five sessions for each schedule are presented in Fig. 1 as a function of the VR schedule for the three birds. The curve describing this function shows an increase between the VR 50 and VR 100 for two birds, and then a decrease—although it tends to be slight—for all three birds as the ratio contingency was increased to VR 200. The double points on the figure at VR 100 and VR 200 represent the original and re-determined points, which closely approximate one another.

Typical cumulative records, representing the median sessions plotted in Fig. 1 are pre-

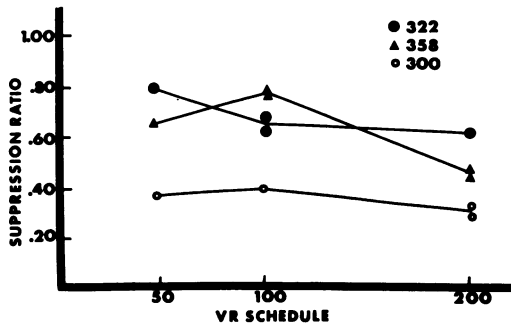


Fig. 1. Median suppression ratios for the three birds as a function of the variable reinforcement schedule. The duplicate points on the curve at the VR 100 and VR 200 indicate the original and redetermined ratio.

sented in Fig. 2. The curves reveal a high rate of response during the first portion of every CS shock trial for all three schedules. On some occasions, the subject continued to emit re-

sponses during the CS until one or more reinforcements were obtained followed by complete suppression. On other occasions, the subject showed an abrupt decrease in rate to zero, independent of reinforcement, or displayed no suppression.

DISCUSSION

An analysis of these data in terms of a reinforcement frequency interpretation, as derived from conditioned suppression on variable interval schedules (Carlton and Didamo, 1960; Lyon, 1963; Lyon, 1964) is complicated by extreme variability in the response rate during the CS. Since the presentation of a reinforcement was contingent upon the emission of responses, the response rate during the CS tended to be at a high rate or at zero for the VR 50 as well as the VR 200, although a few

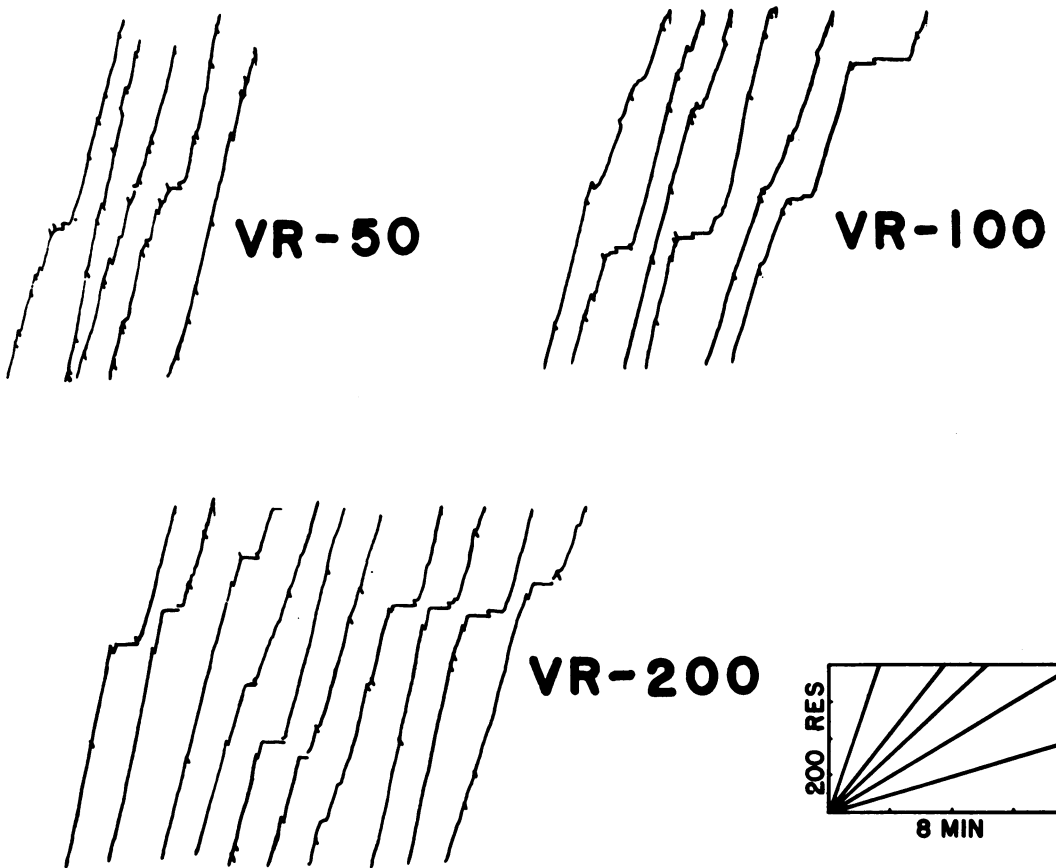


Fig. 2. Typical cumulative records for the three variable ratio schedules for bird 322. The CS onset is indicated by a 1 min downward deflection of the pen. Reinforcements are indicated by a downward pip, or an upward pip of the pen during the CS.

trials with some intermediate responding were also recorded. In addition, the rate during most CS trials changed abruptly, which was not always correlated with the presentation of a reinforcement on the VR-100 and VR-200 schedules. As a result of the high response rate and the abrupt changes in rate during the CS, the degree of suppression was quite variable from trial to trial. It is, therefore, quite difficult to assess the effect of changes in an experimental variable on this baseline.

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