

SOME NOTES ON CONDITIONED SUPPRESSION AND REINFORCEMENT SCHEDULES

DAVID O. LYON^{1,2}

INDIANA UNIVERSITY

Two pigeons were trained on an FR 150 schedule of reinforcement. An Estes-Skinner conditioned suppression procedure was then superimposed on this performance at varied intervals. If the CS occurred during the early stages of the ratio run, complete suppression resulted. If the CS occurred during the later stages of the run, the birds continued to respond until the reinforcement was obtained, which was then followed by complete suppression.

It has been found (Estes and Skinner, 1941) that responding maintained by positive reinforcement shows a rate decrease during a relatively short-duration stimulus which terminates independently of the animal's behavior and coincidentally with an unavoidable electric shock. The rate decrease has been called "conditioned suppression." Brady (1955) studied the extinction of conditioned suppression on variable interval and ratio schedules of reinforcement. His results suggested that the reinforcement contingency was indeed a significant feature of the situation, since the suppression behavior extinguished more rapidly on the ratio schedules than on the variable interval schedules. On the basis of these data and a study by Stein, Sidman and Brady (1958), Geller (1960) suggested that the magnitude of conditioned suppression on variable interval as well as fixed ratio schedules of reinforcement was a function of the reinforcement frequency. This interpretation has been supported for variable interval schedules (Lyon, 1963). The results of an unpublished study by the present author, however, showed no consistent behavioral relationship between the reinforcement frequency and the degree of suppression on a multiple VI FI FR schedule of reinforcement. Inspection of the cumulative records from this study indicated the possibility that conditioned suppression on the FR schedule might depend on the relationship be-

tween the CS onset and the reinforcement proximity. In the present study the degree of conditioned suppression was measured on an FR schedule as a function of the scheduled relationship between the CS onset and the presentation of the reinforcement.

METHOD

Subjects

Two adult, white Carneaux, barren hen pigeons, which had been used in the multiple schedule experiment mentioned in the introduction, 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.

Apparatus

A 15.5 by 13 by 11 in. response chamber was constructed in a commercial ice chest, and fitted with a 15 cfm exhaust fan to provide ventilation. The response key was a .75 in. back-lighted translucent disk mounted 8 in. above the chamber floor. It required approximately 6 g force to operate. Located 4.5 in. below the key was a 2 by 2 in. opening through which a grain hopper, containing 50% Kaffir, 40% Vetch, and 10% Hempseed, could be made available. The reinforcement was a 4-sec presentation of this hopper.

The inside illumination was provided by two 5 w lamps mounted behind 1 in. circular milk glass lenses. These lamps were mounted 4 in. from either side of the key, 1.5 in. below the chamber ceiling. During reinforcements these house lights were extinguished, and a

¹Reprints may be obtained from the author, Psychology Department, Western Michigan University, Kalamazoo, Michigan.

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small white light in the reinforcement chamber came on.

The apparatus for delivering the shock was similar to the device described by Hoffman and Fleshler (1959). A short piece of beaded chain was wrapped twice around the upper part of each wing of each bird. To the chain on each wing, a short piece of retractable cord was fastened with alligator clips. This cord led to a phone jack in the response chamber ceiling, 7.5 in. from the key. A buzzer was used as the shock-correlated stimulus (CS). The shock level was adjusted to 30 v by a variable transformer, and programmed by a 20 msec pulse former to provide the aversive stimulus.

The procedure was programmed by appropriate electro-mechanical timers and relay circuitry. The number of responses before and during each CS were recorded on separate channels of a print-out counter. Cumulative response curves were collected from a Gerbrands recorder.

Procedure

Two pigeons, PC-5 and PC-14, were trained on a FR 150 schedule of reinforcement. The daily sessions were terminated after *S* had obtained 50 reinforcements. After this performance was stable, which required approximately 10 sessions, an Estes-Skinner conditioned suppression procedure was superimposed on this baseline. A 1-min auditory stimulus was programmed at varied intervals, so that it was presented at various positions in the ratio run, and terminated with the delivery of a 20 msec 30 v shock. The interval between stimuli was varied between 3 and 7 min. After the suppression behavior was stable, the magnitude of the suppression was measured during a minimum of 50 CS-shock trials. During this phase *S*s received 12-16 CS-shock trials per session.

RESULTS

The results were analyzed in terms of the total number of responses during the CS as a function of the position in the ratio run where the CS onset occurred. These data are presented in Fig. 1 and 2 for the two birds. Each point on the curve represents a single CS-shock trial. The diagonal line indicates the number of responses necessary to obtain a reinforcement during the CS as a function of the position in the ratio run. Each point on this line

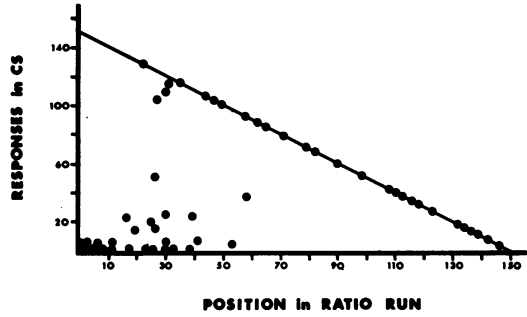


Fig. 1. The number of responses in the CS as a function of the position in the ratio run where the CS onset occurred. Each point represents a single CS-shock trial for pigeon PC-14. The diagonal line indicates the number of responses necessary to obtain a reinforcement in the CS as a function of the position in the ratio run. Each point on this line indicates *S* was reinforced during the CS.

indicates that *S* was reinforced during the CS. If the subject continued to respond after the reinforcement was delivered the point would appear above this line. It is interesting to note that there is only one point above this line (see Fig. 2).

In general, the curve indicates three separate response patterns. If the CS occurred within the 0-20 response range of the ratio, complete suppression usually resulted. If the CS occurred within the 20-60 range, on some occasions *S*s continued to respond until the reinforcement was obtained. On other occasions, *S*s emitted a few responses or exhibited complete suppression. These variations in the response pattern were not due to daily fluctuations, since some of the differences in this 20-60

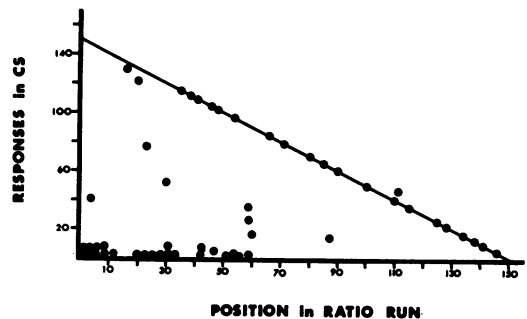


Fig. 2. The number of responses in the CS as a function of the position in the ratio run where the CS onset occurred. Each point represents a single CS-shock trial for pigeon PC-5. The diagonal line indicates the number of responses necessary to obtain a reinforcement in the CS as a function of the position in the ratio run. Each point on this line indicates *S* was reinforced during the CS, and a point above the line indicates the occurrence of responses after the reinforcement.

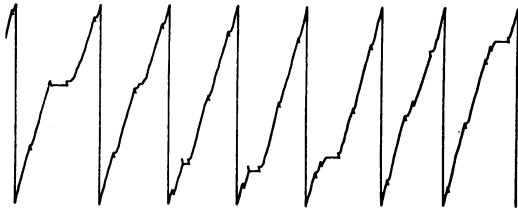


Fig. 3. Cumulative records for one bird, PC-14, illustrating typical suppression behavior patterns on an FR 150. The 1 min vertical displacement of the pen represents CS onset. Reinforcements are indicated by a downward pip of the pen, or an upward pip during the CS.

range were observed within a single experimental session, and occasionally on successive trials. If the onset of the CS occurred in the 60-150 range, almost invariably *S* would continue to respond until the reinforcement was obtained, which was then followed by complete suppression.

Typical cumulative records of the response pattern observed under these conditions are presented in Fig. 3 for one bird, PC-14. The curves indicate the typical changes in the suppression behavior as a function of the scheduled relationship between the CS and the reinforcement. Each of the six CS-shock trials are indicated by a vertical displacement of the pen for 1 min. Reinforcements during the CS are indicated by an upward pip of the pen. The first trial clearly indicates complete suppression found when the CS onset occurred during the post reinforcement pause. In the next two trials, the CS onset occurred during the later stages of the run and *S* continued to respond until the reinforcement was obtained, which was then followed by complete suppression. The last three trials are of particular interest since the CS onset occurred at approximately the same point during these runs. During the second trial of the last three *S* continued to respond during the CS and was reinforced just as the CS was terminated. In the other two trials *S* emitted a few responses followed by complete suppression.

DISCUSSION

In general, the results of the present study indicate that suppression behavior is influenced by baseline reinforcement variables other than reinforcement frequency, depending on the reinforcement schedule employed to maintain the baseline behavior. The present study does not provide data for a definitive test of this hypothesis, but the results do indicate that the critical determinant of suppression behavior on an FR 150 at least is the relationship between the CS onset and the reinforcement proximity. Thus, these data seem to indicate that the reinforcement contingency may be one of the more important determinants of conditioned suppression. When, as in a variable schedule, the scheduled presentation of the reinforcement is not fixed with respect to time or the number of responses, the relationship between the onset of the CS and the occurrence of a reinforcement is not specifically determined. Under these conditions, the severity of the suppression behavior should be determined by the frequency of reinforcement. With a fixed schedule, however, there is a fixed relationship between the occurrence of a reinforcement and the onset of the CS. Under these conditions, the severity of the suppression should be related to the placement of the CS onset with respect to the reinforcement.

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