Concurrent schedules of reinforcement and punishment¹

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Steady responding was established on a Multiple Fixed-ratio schedule of reinforcement in four White Carneaux pigeons. Single response punishments were then programmed in each component. Generally the position of the punishment within the ratio requirement determined the change in local rate. If punishment occurred on the first response, post reinforcement pausing increased. If punishment was delivered on the middle response, disruption in rate occurred during the first half of the ratio. If the last response was punished, rate decelerated as the ratio requirement was near completion.

Concurrent intermittent schedules of reinforcement have been investigated by Dardano & Sauerbrunn (1964). Using pigeons as Ss, a fixed-ratio schedule of punishment was introduced upon a fixed-ratio schedule of reinforcement. When electric shock was contingent upon the first response of the ratio, a selective effect similar to that reported by Azrin (1959) occurred as an increase in the post reinforcement pause. Introduction of the aversive stimulus within the ratio produced marked changes in the local rate of responding typical of fixed-ratio schedules. The pattern of responding resulting from internal shocks was a function of the position of the shock in the ratio.

The introduction of multi-element baseline techniques makes possible nearly simultaneous observation of different contingencies within the same organism thus permitting the isolation of factors which have not yet been investigated. Among these are interactions between different schedules of punishment. The present research was an attempt to further explicate the behavioral effects of interactions between concurrent schedules of punishment and reinforcement.

Method

Four White Carneaux pigeons maintained at 80% of ad lib weight were used as Ss. These birds had an experimental history of exposure to fixed-ratio reinforcement schedules and punishment before the present investigation was performed. A Lehigh Valley 1519C pigeon box served as the experimental chamber. A response consisted of a peck against a translucent key sufficient to close a microswitch. Punishment was a 60 cycle ac shock delivered through 10,000 ohms in series with the bird. The shock was delivered through electrodes implanted around the pubis bone of the bird.

Multi-element baselines of fixed-ratio 40 or 50 were used to establish steady responding. Two-min. periods of red and green lights were alternated on the translucent key which served as the response mechanism. Throughout the experiment, the same fixed-ratio schedule of reinforcement was programmed for each key

color. When shock was introduced, the key color served as a discriminative stimulus for the programmed punishment contingency.

Once stable responding had been established, the effects of a single response punishment were studied by exposing some Ss to punishment contingencies in which first response punishment was programmed to occur in one ply and middle or last in the other ply. Others were exposed to middle punishment in one ply and last in the other ply.

Results

Figure 1 provides cumulative record comparisons of the effects under several punishment conditions. The most consistent effect occurred when punishment was contingent upon the first response of each ratio as illustrated by the increased post reinforcement pausing in the cumulative records for P-73, P-91, and P-90.

Punishment of the middle response, indicated in the records of P-73, P-91, and P-69, produced two consistent effects. Some of the ratios were executed at a decelerated rate prior to the delivery of the punishment. The last half of the ratio was then completed at the S's typical ratio rate. These effects appear as "scallop" in the ratios illustrated during the last two segments in the record of P-73. The second consistent effect appeared as clear breaks in the ratio run as evidenced in the records of P-73, P-91, and P-69 in Fig. 1 prior to the delivery of punishment on the middle response.

Two Ss, P-69 and P-90, were exposed to punishment of the last response in one ply of the multiple schedule. Typically deceleration in rate occurred as the ratio run was near completion.

Fig. 1. Cumulative records of conditions in which a single response was punished in each ratio during each ply.

Fig. 2. Polygraph recordings of segments from each ply of the multiple schedule. Punished response is indicated by a mark above the response distribution. Intact segments were selected to permit comparisons across the two punishment contingencies. Responding is initiated on the left.

Ratios abstracted from polygraph recordings of response distributions after punishment had been introduced are shown in Fig. 2. Comparisons of the two conditions within the same organisms reflect differences in rate largely determined by the location of the punished response in the ratio requirement. Occasionally one ply of the multiple schedule was characterized by changes in local rate typical of the point at which punishment was delivered for both contingencies. A typical segment of P-69's record is presented showing deceleration both in the middle and end of the on-going ratio even though punishment was contingent only on the middle response.

These polygraph recordings are presented from each ply according to the same time base so that comparisons can be made between pausing following reinforcement and local rate changes. Note particularly P-73's record where only two ratios were completed when punishment was contingent upon the first response and three ratios when punishment was contingent upon the middle response.

Polygraph recordings for P-91 indicate that a discrimination is made on the basis of the punishment contingency, but this deceleration in local rate cannot be seen on the cumulative record presented in Fig. 1. A deceleration in rate occurred after high initial responding which was followed again by high rates after the punishment was delivered on the middle response.

Discussion

The results of a single response punishment reflect the same general trends as have been reported by Dardano & Sauerbrunn (1964). These authors reported that punishing the first response of each ratio produced an increase in the post reinforcement pause with no disruption in local rate. When responses in either the middle or last portion of the ratio requirement were punished, changes in local rate occurred.

Although in many instances the effects were brought under stimulus control, some evidence of interaction between the two components was present in this study. When the middle response was punished in one ply and the last in the other, the effects became attenuated so that responding often fluctuated both in the first and last halves of the ratio. This may be a function of the amount of training with single response punishment. Only a short time was allowed for these Ss to recover from the differential punishment contingency of first response and continuous punishment (DeArmond, 1966) before single response punishments were introduced. Another factor may be the lack of discriminative control the middle response has over responding either in the first half or the last. Since the first response is a special event and the last response is followed by reinforcement, both these responses may provide greater control over behavior. Introducing punishment permits increased control over responding as compared to the middle response.

Prolonged experiences with fixed ratio have generated rates which were less sensitive to the potentially disruptive punishment contingencies. Another factor which may be considered in addition to the behavioral history of fixed ratio responding is the fact that each component was only in effect for 2 min. at a time. This may not have provided enough opportunities for the behavior to come into contact with the punishment contingency.

References

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Note

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