Autoshaping accurate discriminations in pigeons*

ROGER SCHNAITTER
Illinois Wesleyan University, Bloomington, Ill. 61701

and

STEPHEN WINOKUR
Texas Christian University, Fort Worth, Tex. 76129

Nine naive pigeons were autoshaped, and learned a discrimination based on a multiple variable-interval 3-min extinction schedule of reinforcement. All birds learned rapidly and made few errors. Tests for behavioral contrast indicated that none was produced. As transfer tests, six birds were shifted to a schedule that caused a reversal of the discrimination they had mastered; three birds were shifted to a new nonreversed discrimination. Both transfer tasks were learned with errors but without behavioral contrast. The reversal shift was learned more rapidly than the nonreversal shift.

Autoshaping has been shown to be an effective technique for generating and maintaining pecking in naive pigeons (Brown & Jenkins, 1968). Most investigations of autoshaping have been concerned with the range of species which may be autoshaped or the processes responsible for the phenomenon (Sidman & Fletcher, 1968; Smith & Smith, 1971; Williams & Williams, 1969; Herrnstein & Loveland, 1972). These and other reports indicate that, other than during stimulus presentations, little or no responding occurs (Bilbrey & Winokur, 1973). Furthermore, autoshaping has been shown to be an extremely rapid method for inducing pecking (Brown & Jenkins, 1968; Bilbrey & Winokur, 1973). Thus, it appeared that autoshaping had the potential of being an effective method of rapidly training very accurate discriminations. Experiments I and II were performed in order to determine the effects of autoshaping on original discrimination learning, reversal and nonreversal shift transfer tasks, and behavioral contrast.

EXPERIMENT I

Method

Subjects

Six naive male homing pigeons, 1-2 years old, were maintained at 80% of their free-feeding body weights by supplementary feedings at the end of each daily session. Reinforcements and supplementary feedings consisted of Purina Pigeon Checkers. Water and grit were available ad lib in the birds' home cages.

Apparatus

A Grason-Stadler three-key pigeon box was used. The side keys were uncovered and unlit; pecks at them had no programmed consequences. White noise at about 80 dB and a 10-W houselight were presented at all times in which the birds were in the box. Electromagnetic programming and recording equipment was located in a sound-shielded room adjacent to the one housing the box.

Procedure

Each bird was adapted to the box for 2 successive days for 45 min per day. During this time, all keys were uncovered but unlit and the feeder did not operate.

On the following day, magazine training began for all of the birds. Initially, the full, illuminated feeder tray was continuously available. When the birds were observed eating, food presentation was programmed on a VT 1-min schedule, with food access time set at 30 sec. During the course of this session, in which 20 reinforcements were presented, access time was reduced to 7.5 sec. During the second half of this session, Bird 5B pecked 31 times in 10 min.

On the fourth day, an autoshaping procedure began. The center key was illuminated with a green light on a VT 1-min schedule. At the termination of the varying time interval, the key became red for 5 sec. At the termination of the red light, the key became dark and the feeder was illuminated by a white light and operated for 5 sec. Immediately after reinforcement, the green light was turned on. Responses to the green key were ineffective, while each response to the red key was reinforced; 50 presentations of the red key occurred on this day. The same procedure was in effect on the immediately following day.

On the next day, the following schedule was introduced: The green light was on for a fixed interval of 1 min and was immediately followed by the red light. The first peck after the red light had been on for 15 sec operated the feeder for 5 sec and then turned on the green light. Pecks at the green key were recorded but unreinforced. During the next 2 days, the FI schedule correlated with the red light was changed to FI 30 sec for 20 reinforcements, and then to FI 1 min for 20 reinforcements. In the next session, the green EXT component was lengthened to a fixed 1.5 min, the schedule correlated with the red key was FI 1.5 min and 15 reinforcers were allowed. During the next four sessions, the duration of the EXT component and the FI length were both increased to 3 min.

Then the following multiple schedule of reinforcement (mult VI 3 EXT) was used: The green and red key lights were presented for 10 min in simple alternation. In each daily 1-h session, the green light (EXT) was always presented first. During the red light (S+), reinforcement was available on a VI 3-min schedule. This multiple schedule remained in effect for 20 days.

Subsequently, for a period of 10 successive days, the birds were exposed to sessions of 30 min, during which only the S+ appeared on the key. The schedule of reinforcement remained at VI 3 min, and the number of reinforcements received by each bird during each session remained at approximately 10. After these 10 sessions, the birds were returned to the mult VI 3 EXT schedule for an additional 10 days.

Exposure to a reversed mult VI 3 EXT schedule followed during the next 18 sessions. During these 18 sessions, reinforcement occurred in the presence of the green light and extinction was in effect in the presence of the red light. Other characteristics of the procedure remained the same as before.

Results and Discussion

Figures 1 and 2 display the daily response rates of each bird in each component of each session. It may be seen that, with the exception of Bird 4B, asymptotic response rates were reached by the third day of the autoshaping procedure. Rates of pecking remained stable

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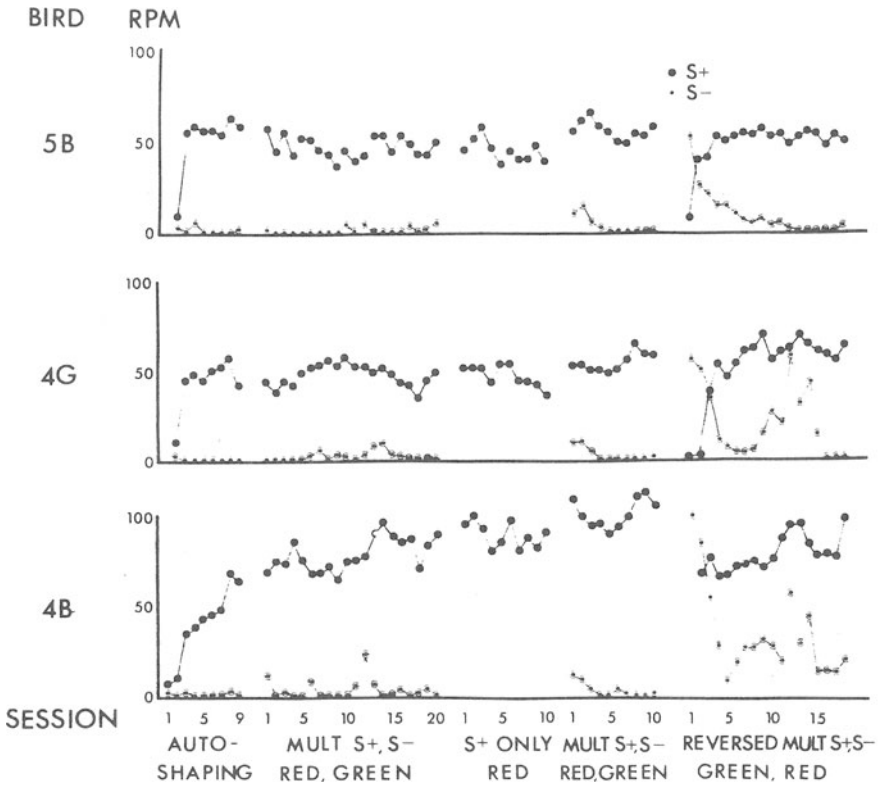

Fig. 1. Daily response rates in responses per minute in each component of the schedules in effect during Experiment I.

throughout the first four phases of Experiment I. The sharp dips in rates on Day 6 of the first mult VI 3 EXT procedure were due to E errors. Response rates in the nonreinforced schedule components were low and usually near zero. Discrimination indices were computed by dividing response rates in reinforced components by total response rates. Each bird's discrimination index exceeded 0.9 by the third day of autoshaping and

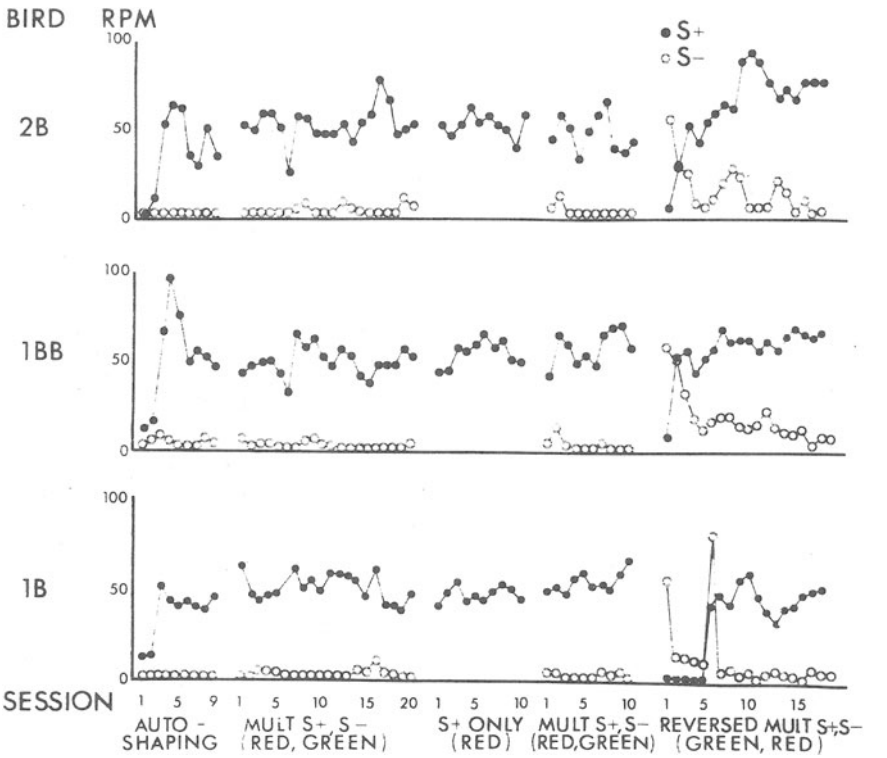

Fig. 2. Daily response rates in responses per minute in each component of the schedules in effect during Experiment I.

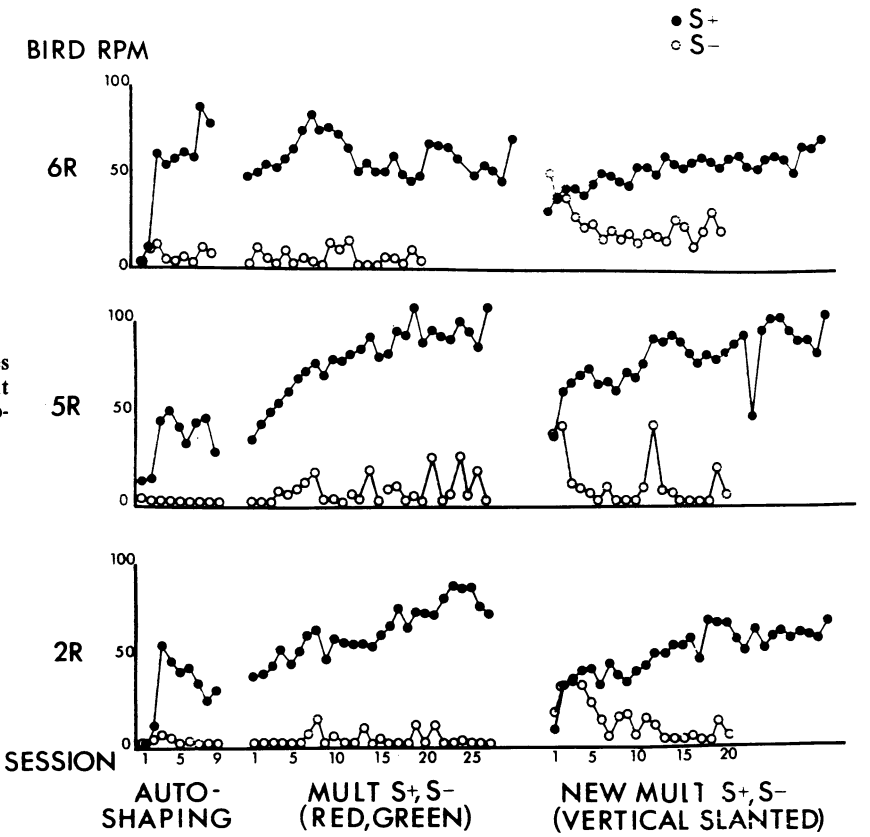

Fig. 3. Daily response rates in responses per minute of each bird in each component of each schedule in effect during Experiment II.

remained well above that level until the reversed mult VI 3 EXT schedule was put into effect. Because of their uniformity and because they are directly derived from the data depicted in Figs. 1 and 2, the discrimination indices have not been presented here.

When the reversed mult VI 3 EXT schedule was put into effect, responding to the formerly unreinforced green light rapidly increased and, for all birds except 1B, reached its former asymptotic level by the end of the fourth day of this procedure. Responding to the formerly reinforced red key declined more slowly and occasionally recovered. With the exception of Bird 1B, discrimination indices reached and remained above 0.9 by the fourth day of exposure to the reversed mult VI 3 EXT schedule.

Clearly, the birds learned both the original and the reversed red-green discriminations with great accuracy and substantially greater speed than had been reported previously (Terrace, 1966). It may be noted that rates of responding were unchanged when the S+ (red light) was presented alone for 10 sessions. Thus, according to Terrace's (1966) test, no behavioral contrast was produced in Experiment I. This result is similar to that found by Terrace when employing his errorless learning procedure. It may also be noted that when the discrimination was reversed, the new discrimination was learned less rapidly and more responding in the unreinforced component (errors) occurred. This result is also similar to those obtained with Terrace's procedure.

EXPERIMENT II

Method

Three naive male homing pigeons were adapted, magazine trained, autoshaped (10 days), and received training on the mult VI 3 EXT schedule (25 days for Birds 2R and 5R, 20 days for Bird 6B), as did the birds of Experiment I. Bird 6B also had 10 days of training in the S+ only condition. Then all three birds were exposed to a new nonreversed discrimination for 20 daily 1-h sessions. When vertical black and white stripes were on the key, pecking was reinforced on a VI 3-min schedule. No reinforcement occurred in the presence of slanted (45-deg angle) stripes. Key illumination changed every 10 min in simple alternation.

Results and Discussion

Figure 3 displays response rates of each bird in each component of each session. The data of the autoshaping and mult VI 3 EXT procedures are comparable to those of Experiment I. In the new nonreversed discrimination, reinforced responding increased more slowly than in Experiment I, while nonreinforced responding declined more slowly. Birds 2R and 5R achieved discrimination indices in excess of 0.9 by the 10th day of this procedure. As in Experiment I, no behavioral contrast appeared in Experiment II. Kendler reported (1968) that adult humans find reversal shifts easier than nonreversal shifts of discriminations, but rats find nonreversal shifts easier. Examination of the results of the transfer tests of Experiments I and II indicates that pigeons appear to resemble adult humans more than they do rats in their performance on tasks of this sort.

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