Maximizing the nonoccurrence of time-out as a function of FR requirement and time-out duration

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Pigeons responded on either a FR10 or FR20 schedule for food reinforcement in a discrete-trial probability-learning situation. Responses to one color produced time-outs (2 or 5 sec) 70% of the time, while responses to another color produced time-outs only 30% of the time. All Ss learned to maximize the nonoccurrence of time-outs by selecting the 30% color on nearly every trial. Ss responding on the FR20 schedule reached the maximizing criterion significantly faster than did Ss responding on FR10. The results indicate that time out and shock have similar functions in probability-learning experiments.

Probability learning with aversive reinforcement has been virtually neglected relative to the appetitive case. Cole, Belenky, Boucher, Fernandez, & Myers (1965) varied shock intensity in a T-maze situation with rats and observed that the probability of choosing the less frequently shocked arm increased well above the matching value (67%) with increasingly severe shocks. Similarly, Young & Peeke (1966) showed that goldfish will choose the less frequently shocked compartment of a shuttlebox with a frequency significantly greater than the matching value (80%) but significantly lower than the maximizing value (100%). However, both studies terminated acquisition before an asymptotic level of responding was reached (i.e., the curves were still increasing), thereby preventing complete maximizing of the nonoccurrence of shock.

Although shock is the most commonly used form of aversive reinforcement, other possibilities are available. For example, the fact that time-out (TO) from positive reinforcement will maintain avoidance and escape responding (Baer, 1960; Thomas, 1965) as well as punish responding (Baron & Kaufman, 1969; Kaufman & Baron, 1968) provides empirical support for Leitenberg's (1965) conclusion that TO is an aversive event.

The purpose of the present experiment was to determine whether or not pigeons maximize the nonoccurrence of TO in a probability-learning situation with extended training, while responding for food reinforcement on a fixed-ratio (FR) schedule. In addition, the FR requirement

and TO duration were manipulated across Ss to assess the effect of these variables.

SUBJECTS

Eight male White King pigeons, individually housed, served as Ss and were maintained at approximately 80% of their free-feeding weights for a period extending from 1 week prior to the experiment through the duration of the experiment.

APPARATUS

A two-key pigeon chamber, 11 x 11 x 13½ in., was located within a modified picnic chest. The 1-in.-diam keys were centered, 9 in. from the floor and 5 in. apart, on a metal panel separating the S's chamber from the area containing the stimulus- and food-presenting mechanisms. A minimum force of 10 g was required to operate the keys, and responses produced auditory feedback. One-plane read-outs allowed red and green colors to be projected on both response keys, and the experimental chamber was diffusely lighted from above by a 15-W lightbulb. Three inches from the bottom of the intelligence panel was centered a 2 x 2 in. opening, through which a solenoid-operated grain hopper could be presented. Reinforcement consisted of a 3-sec access to the illuminated grain hopper. A blower functioned throughout the experiment to mask extraneous sounds and to regulate the temperature inside the chamber. A system of automatic controlling and recording equipment allowed the data to be collected in a separate room.

PRELIMINARY TRAINING

On Days 1-3, Ss were magazine trained and shaped (CRF) to respond to both colors and positions. On Days 4-5, Ss were placed on a forced single-alternation schedule, with the left and right keys being red and green, respectively, on Day 1 and vice versa on Day 2. Only one key was illuminated at a time, and a single response produced reinforcement. Illumination of the other key occurred simultaneously with withdrawal of the grain hopper. Responses to darkened keys had no programmed effect. On Days 6-8, the single-alternation schedule was continued, but the response requirement was gradually increased simultaneously on both keys so that individual Ss had to respond according to either a FR10 or FR20 schedule to obtain a single reinforcement. On Days 9-11, Ss were allowed to adapt to their respective FR schedules. A total of 30 reinforcements were allowed each day and

the alternation of colors from right to left continued daily.

Phase 1

This phase was initiated to assess the effectiveness of preliminary training in eliminating any color and/or position preferences. The alternation requirement was eliminated, and Ss were free to choose between the various colors and positions on a discrete-trial basis. The keys were illuminated simultaneously, one being green and the other red. Once a given color and key were selected by a response, the remaining key became blank and inoperative, and Ss were forced to produce reinforcement on the initially chosen key. Once the FR requirement was satisfied and reinforcement was obtained, a 5-sec complete blackout occurred and functioned as the intertrial interval. The keys were then illuminated simultaneously once again, and Ss could make another choice. The red and green colors were presented on the left and right keys according to a random sequence, with each color occurring equally often in each position. Phase 1 continued for a minimum of 6 days (30 reinforcements each day) for all Ss or until it was obvious that a S possessed no color and position preferences.

Phase 2

For all Ss, this phase began on the day following the completion of Phase 1. The procedure was identical to that in Phase 1, with the exception that a certain percentage (70 or 30) of the responses to the various colors produced TO of fixed duration (2 or 5 sec). For example, 70% of the responses to the red stimulus and 30% of those to the green stimulus always produced a 5-sec TO, regardless of the position of the colors; other Ss might have green and red associated with 70% and 30% TO, respectively. The entire chamber was darkened during TO, and responses were without consequence. Following TO, only the key and color selected on that trial were illuminated, and S was free to respond until the next TO occurred. The specific pattern of responses producing TO was changed daily for all Ss. Ss received 30 trials daily, and each trial terminated with reinforcement. Ss were run until they met the criterion of choosing the 30% stimulus on 28 or more trials for 3 consecutive days.

RESULTS AND DISCUSSION

Table 1 presents the frequency of choosing the 30% stimulus across days for all Ss. In addition, the 30% stimulus color (R = red, G = green), the FR requirement (10 or 20), and TO duration (2 or 5 sec) are given for each S. Table 1 indicates that all Ss initially chose the 30% stimulus on about half the daily trials, and this tendency supports the notion that Ss

Table 1
Individual Daily Frequencies of Choosing the 30% Stimulus (Daily Maximum = 30)

			TO	Days																		
S	FR	30% Color	Dura- tion	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	10	G	2	16	14	11	16	13	12	13	14	13	19	16	20	18	17	14	29	28	28	
2	10	R	2	15	15	20	19	14	19	18	17	20	19	19	19	19	29	21	22	29	28	30
3	10	G	5	12	17	16	19	16	20	15	23	20	21	21	23	18	24	24	24	28	28	29
4	10	R	5	15	14	17	16	16	18	19	20	19	28	23	22	29	26	29	30	30		
5	20	R	2	18	16	19	23	26	27	27	22	18	29	26	21	24	28	28	28			
6	20	G	2	12	14	17	10	5	6	19	20	24	24	24	30	30	28					
7	20	R	5	15	13	16	20	26	20	21	18	20	16	14	19	27	28	28	28			
8	20	G	5	12	14	15	17	19	16	16	18	17	18	19	24	20	28	29	29			

lacked any initial color preference. More importantly, inspection of Table 1 reveals that all Ss gradually developed a preference for the 30% stimulus until they were choosing it on nearly every trial. This result indicates that pigeons, given extended acquisition, will maximize the nonoccurrence of TO in a probability-learning situation while responding for food reinforcement. The importance of extended acquisition in probability-learning studies has been noted elsewhere (Shimp, 1966; Topping & Parker, in press), and the present findings suggest that previous probability-learning experiments with shock reinforcement might have resulted in complete maximizing had more training been given.

A one-way ANOVA used to assess the effect of TO duration on the rate of reaching the maximizing criterion revealed that this main effect was not significant ($F < 1$). This result is inconsistent with previous research (cf. Kaufman & Baron, 1968), which has found that the effectiveness of TO is an increasing function of its duration; however, the lack of a differential effect in the present study was probably due to the small difference between the durations used.

A similar analysis indicated that the FR requirement had a significant differential effect ($F = 15.76$, $df = 1/6$, $p < .01$), with the larger FR value resulting in more rapid maximizing. Thompson (1964) observed that rats show an increasing preference for TO as the FR requirement increases. He attributed this finding to the increasing aversiveness of the FR schedule as the response requirement became more and more strained. The fact that all Ss maximized the nonoccurrence of TO in the present study suggests that FR values of 10 and 20 are not particularly aversive, but that TO is aversive. Thus, there appears to be some type of curvilinear relationship between the FR requirement and preference for TO. Investigations in the Es' laboratory have been planned to investigate the nature of this relationship as well as the possible interaction of FR requirement and percentage and duration of TO.

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Retention of habituation of exploratory behavior

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Two groups of rats were tested in an open field. One group was exposed to a novel stimulus change with the field. After 90 days, animals were retested with both groups experiencing the stimulus change. The group having had prior exposure showed retention of the habituation of exploratory behavior.

In studying open-field activity in normal rats as compared to Ss with septal and amygdaloid preparations, Corman, Meyer, & Meyer (1967) used a procedure that seemed especially suited to investigating exploratory behavior. Using an open field divided into equal squares, these authors measured locomotion, number of squares traversed, time in center (time spent in squares not bordering on the walls of the field), and latency in leaving the startbox,

both before and after the insertion of a novel stimulus in the center of the field.

Extending this work specifically to the investigation of exploratory behavior, Corman & Shafer (1968) demonstrated that the introduction of a white square into the center of a homogeneous black field elicited approach behaviors that habituated with repeated testing. The present study was undertaken to examine the effects of interspersing a substantial period of nonexposure to the test situation on the habituation of tendencies to approach the white square.

SUBJECTS AND APPARATUS

The Ss were 18 male hooded rats, approximately 30 days old at the beginning of gentling. Food and water were continually available to the Ss except during the experimental sessions. Ss were ear-punched for identification.

The apparatus, as described by Corman & Shafer (1968), was a 45-in. square open