*RESPONSE-PRODUCED TIMEOUTS UNDER A
PROGRESSIVE-RATIO SCHEDULE WITH A
PUNISHED RESET OPTION*

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Three behavioral options were available to food-deprived pigeons: (1) pecking one key resulted in food reinforcement according to a 50-response progressive-ratio schedule, (2) pecking a second key reset the progressive-ratio schedule to the initial progressive-ratio step, and (3) pecking a third key produced a 3-min timeout period. Pecks on the reset key were shocked. Under low and intermediate shock intensities, timeouts were not produced; under high shock levels, timeouts were produced regularly. Timeouts occurred during the initial period of a progressive-ratio step and were more frequent during the longer steps of the progressive-ratio schedule. Response-produced timeouts under these experimental conditions could be interpreted either as an escape from aversive behavioral options or as a low-probability behavior emerging when the food reinforcement schedule exerted weaker control.

In studies dealing with response-produced timeouts, the subject has the option of responding on an added manipulandum which results in a timeout period, generally defined as a temporary suspension of the reinforcement schedule with a correlated stimulus change (Ferster and Skinner, 1957; Leitenberg, 1965). The production of timeouts from a schedule of negative reinforcement would seem an adaptive behavior because the timeout temporarily eliminates aversive controlling stimuli. Some properties of response-produced timeouts under avoidance schedules have been described by Sidman (1962) and Verhave (1959, 1962). The production of timeouts from schedules of positive reinforcement appears to be a more complex phenomenon. Azrin (1961) demonstrated that pigeons pecking under fixed-ratio food schedules pecked a second key that initiated and terminated a timeout period. The timeouts occurred during the post-reinforcement pause, and their frequency and

duration were directly related to size of the fixed-ratio schedule. These findings have been replicated, in most respects, by Appel (1963) and Thompson (1964, 1965). Later studies reported timeouts from positive reinforcement under a progressive-ratio schedule (Dardano, 1973), variable-interval schedules (Brown and Flory, 1972), and during a particular component of a successive discrimination procedure (Rilling, Askew, and Ahlskog, 1969).

Response-produced timeouts from positive reinforcement have been interpreted in different ways. The timeout response could be a form of schedule-induced escape behavior (Azrin, 1961; Thompson, 1964); the stimulus change at the onset of the timeout period could be a positive reinforcer (Appel, 1963); a weaker control by the positive reinforcement schedule could underlie responses on a timeout key (Zimmerman and Ferster, 1964); the timeout response occasionally might be part of an aggressive reaction induced by unfavorable reinforcement conditions (Gentry, 1968); and the timeout response might be an adjunctive behavior (Falk, 1971), meaning a behavior not directly controlled by the reinforcement schedule but generated indirectly by the reinforcement contingencies.

The present study attempted to extend the generality of timeouts from positive reinforcement to more complex performances. Pigeons

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were provided with three continuously available options. Responses on one key resulted in food reinforcement under a progressive-ratio schedule, which requires a larger number of responses for successive reinforcements; responses on a second key, which were shocked, reset the progressive-ratio schedule to its first step; and responses on a third key produced a 3-min timeout. Some of these conditions have been studied previously (Dardano, 1968, 1973; Findley, 1958). Questions of general interest included the frequency and stability of response-produced timeouts, changes in the properties of the progressive-ratio performance resulting from the occurrence of timeouts, and the similarity of the relationships between timeouts and the reinforced behavior to relationships found under simpler conditions of reinforcement.

METHOD

Subjects

Three male White Carneaux pigeons, approximately 6-yr old, were maintained at 80% of free-feeding weight. Two pigeons, B-24 and B-33, had pecked under a progressive-ratio schedule with a reset option and had been shocked. The third pigeon, B-62, had pecked under fixed-ratio food reinforcement schedules. They were housed in individual compartments with water and grit continuously available.

Apparatus

The experimental chamber, 12 by 13.5 by 13.5 in. (30.5 by 34.3 by 34.3 cm), was furnished with an air blower, a relay for response feedback clicks, a speaker for masking noise, 6-W white houselights, and three translucent response keys that required an approximate force of 18 g (0.17 N) for closure. The keys were mounted behind 0.75-in. (1.9 cm) apertures in the front panel, 9 in. (22.9 cm) above the wire mesh floor, and 2 in. (5.1 cm) apart center-to-center. The left key (timeout key) was transilluminated by a blue light; the middle key (food key) by a red or green light; and the right key (reset key) by a white light. All keylights were 6 W. Each key could be covered by a hinged shield that lowered over the aperture. A square opening, 3 in. (7.6 cm) above the floor, permitted access to mixed grain presented for 3 sec in accordance with a progressive-ratio reinforcement schedule.

A 60-Hz electric shock pulse was delivered to the pigeon by silver electrodes implanted around the pubis bones (Azrin, 1959). The shock circuit included a step-up transformer, milliammeter, and 20-K ohm series resistance. The shock intensity was adjusted by shorting the output of the shocker and pre-setting the desired intensity on the milliammeter. Impedances of the pigeons varied from 800 to 2000 ohms as measured by a bridge circuit with a 7-V, 60-Hz input. The duration of the shock pulse was 50 msec for B-33 and B-62 and 100 msec for B-24.

Procedure

Under the progressive-ratio 50 (PR 50) food reinforcement schedule, the first reinforcement required 50 responses and each succeeding reinforcement required an additional 50 responses (50, 100, 150, *etc.*). Each reinforced response sequence in the progressive-ratio series will be referred to as a step. During the 3-sec magazine cycle, all chamber lights were off and a 6-W white light mounted over the grain hopper was turned on. A single peck on the reset key anytime after completion of the first progressive-ratio step reset the progressive-ratio schedule and changed the color of the food key from red to green, or *vice versa*. If the pigeon pecked the reset key before completing the first step, the accumulated response counted reverted to zero, and the color of the food key remained the same. Any additional responses on the reset key before responding on the food key were inconsequential. The reset option permitted the pigeon to schedule reinforcement after every 50 responses by pecking the reset key after completing the first step. The reset key was transilluminated only after reinforcement on the first progressive-ratio step for B-24 and B-62 and was continuously transilluminated for B-33. An apparent self-scheduled contingency necessitated the different procedure for B-33. When the reset key was illuminated with the schedule used for the other pigeons, B-33 always pecked this key after reinforcement on the first progressive-ratio step, even when intense shock was scheduled for reset responses. Manipulating illumination time of the reset key revealed that illumination onset stopped responding on the food key and produced a response on the reset key.

Under the shock condition, each peck on the reset key produced a single shock. Food-key and timeout-key responses never were shocked. A single peck on the timeout key produced a 3-min period during which all chamber lights were turned off and responses on any of the keys were inconsequential.

All pigeons received the following sequence of four preliminary conditions: (1) the food key and the reset key were available, (2) the food key only was available, (3) the food key, reset key, and timeout key were available, (4) the food key and the timeout key were available. Shock was never scheduled during these four conditions. Before this series of conditions, B-62 pecked under the progressive-ratio food schedule with the reset and timeout keys covered for 55 sessions.

During the experimental conditions, the reset and timeout options were available in every session. After a series of sessions with no shock, an ascending series of shock intensities was scheduled, starting at 2 mA and increasing

in 1-mA steps. A given intensity remained in effect until the performance of the pigeon appeared stable over five consecutive sessions. The criteria for stability were absence of any obvious trends in number of reinforcements, number of resets, number of timeouts, and the overall rate of responding. When the shock intensity reached a level that suppressed reset-key responses to a total of two over five consecutive sessions, the shock condition was removed for a minimum of 20 sessions. The order of the preliminary and experimental conditions plus the number of sessions and reinforcements under these conditions are listed in Table 1.

Each session ended after 2 hr or after 40 reinforcements, whichever came first. Pigeon B-33 was studied six days per week, and the other pigeons were studied seven days per week. The weights and electrical impedances of the pigeons were determined before and after each session. Weights were adjusted upwards by post-session feeding.

RESULTS

Preliminary Conditions

The upper cumulative record in Figure 1 illustrates a final performance under the progressive-ratio schedule without the reset and timeout options. Response rates within each progressive-ratio step were regular and high, the duration of post-reinforcement pauses generally increased during the successive steps, and breaks in responding predominantly occurred during the initial part of the longer steps. The mean number of steps completed in a session by B-24 was 8.4, ranging from five to 11; by B-33 was 6.2, ranging from five to seven; and by B-62 was 10.2, ranging from eight to 12. All values in this report were calculated from the final five sessions unless indicated otherwise.

When the timeout option was available without the reset option, all pigeons responded on the timeout key while pecking under the progressive-ratio schedule. The cumulative response record in the lower half of Figure 1 illustrates the major characteristics of these performances. Chart speed was one-half that of the upper record. Timeouts were more frequent during the longer progressive-ratio steps, occurred during the initial part of a step, and did not modify the temporal characteristics of the progressive-ratio performance. The number of

Table 1

Four preliminary conditions and the main experimental procedure showing the sequence and the number of sessions under each condition. Number of reinforcements shown in parentheses. Notation for conditions: PR 50, progressive-ratio 50 food schedule; TO, timeout; reset, reset of progressive-ratio schedule.

Conditions	Subjects		
	B-24	B-33	B-62
Preliminary			
PR 50 + reset	35 (1400)	64 (2560)	50 (2000)
PR 50	21 (840)	14 (560)	28 (1120)
PR 50 + reset + TO	33 (1320)	51 (2040)	30 (1200)
PR 50 + TO	38 (1520)	32 (1280)	31 (1240)
Experimental			
PR 50 + reset + TO	38 (1520)	20 (800)	8 (720)
PR 50 + reset + 2 mA	27 (1080)	11 (440)	17 (680)
PR 50 + reset + 3 mA	12 (480)	25 (1000)	10 (400)
PR 50 + reset + 4 mA	17 (680)	16 (1380)	19 (760)
PR 50 + reset + 5 mA	11 (440)	28 (1031)	10 (400)
PR 50 + reset + 6 mA	15 (600)	15 (350)	12 (480)
PR 50 + reset + 7 mA	18 (720)	10 (112)	22 (880)
PR 50 + reset + 8 mA	15 (600)	8 (83)	15 (600)
PR 50 + reset + 9 mA	19 (760)	12 (121)	8 (320)
PR 50 + reset + 10 mA	13 (520)	—	13 (520)
PR 50 + reset + 11 mA	14 (560)	—	15 (600)
PR 50 + reset + 12 mA	16 (640)	—	42 (985)
PR 50 + reset + 13 mA	18 (720)	—	13 (174)
PR 50 + reset + 14 mA	30 (1181)	—	7 (64)
PR 50 + reset + 15 mA	15 (275)	—	—
PR 50 + reset + 16 mA	6 (52)	—	—
PR 50 + reset + TO	21 (661)	22 (829)	23 (797)

Fig. 1. The upper cumulative response record shows a final performance under the progressive-ratio schedule (chart speed 60 cm/hr) and the lower record illustrates a performance under the progressive-ratio schedule with the timeout option (chart speed 30 cm/hr). Complete sessions are shown. The momentary deflections of the response pen denote reinforcements and a sustained deflection of the response pen with the added dots denotes a timeout. Records are for B-24.

timeouts in a session for B-24 averaged 10.8, ranging from two to 23; for B-33 averaged 6.5, ranging from five to nine; and for B-62 averaged 15.0, ranging from 12 to 22. The mean number of progressive-ratio steps completed in a session was 1.6 to 1.8 times higher than under the previous condition without the timeout option. Figure 2 presents the mean number of timeouts during each progressive-ratio step. Timeouts predominantly occurred during the second half of the progressive-ratio sequence and were absent in the early steps.

When the reset option was available, the performances were similar with or without the timeout option. The pigeons did not respond on the timeout key when it was available. The progressive-ratio schedule usually was reset

after completion of the first step. Pooling the data from these two conditions, the mean number of reset responses was 33.0 for B-33 and 38.5 for both B-24 and B-62. Response rates within a step were regular and high. The mean overall rate (response per minute) on the food key for both conditions was 133 for B-24, 131 for B-33, and 206 for B-62.

Experimental Conditions

The results of the analysis are summarized in Table 2. Alternate shock intensities are listed until timeouts occurred regularly in the final performances; thereafter, successive intensities are shown. The tabulated data show three general features of timeout-key responding. First, timeout responses were infrequent

Fig. 2. The mean number of timeouts during each progressive-ratio step for each of the pigeons when the reset option was not available. Each point based on data from the final five sessions.

under shock levels less than one-half the maximum intensity scheduled for a pigeon. The only common effect of certain of these lower intensities was a lower overall response rate on the food key, reflecting a longer delay before the reset response. Hence, mildly punishing shock intensities did not lead to timeout responses.

The second feature was the consistent production of timeouts by all pigeons under near-maximum shock intensities. The onset of consistent timeout responses during a session was accompanied by two other developments in the progressive-ratio performance; namely, the

completion of longer steps in the progressive-ratio sequence and lengthy response breaks during the session. These three concurrent changes in the performances under a given shock level appeared abruptly at 14 mA for B-24, 5 mA for B-33, and 12 mA for B-62.

The third feature was the absence of a systematic relationship between shock intensity and the number of timeout responses. After timeout responses regularly occurred under a given shock level, increments in shock intensity did not result in more frequent timeouts, except for B-62. Two other properties of the performance did systematically decline as a function of shock intensity; namely, the number of reset responses and the overall response rate on the food key, except for the rate of B-33 under the maximum intensity.

The cumulative response records of B-24 in Figure 3 illustrate the major characteristics of the performances when timeouts occurred regularly. Final performances are shown under the first shock level associated with consistent timeout responses and under each of the two remaining shock levels. Timeouts occurred as early as the second progressive-ratio step and usually were produced in the initial part of a step. Two or more timeouts within the same step never occurred before the third step of the progressive-ratio sequence. When the pigeons completed a series of steps before resetting the progressive-ratio schedule, timeouts often were produced during a shorter step but not in some or any of the following longer steps. These records also show the longer periods of inactivity during a session as the shock intensity was increased. Note that timeout responses were not frequent during these extended breaks.

Figure 4 shows the relationship between number of timeouts and successive progressive-ratio steps. Since there was no common, systematic change in number of timeouts under the three highest shock intensities, data from the final five sessions under each of these intensities were combined for each pigeon. The graphs in the upper row, which reveal a regular decline in the total number of times each of the progressive-ratio steps was completed, were included to show the fewer opportunities for a timeout response as size of the step increased. The graphs in the middle row show the total number of timeouts during each of the progressive-ratio steps. Pigeon B-33

Table 2

Summary of performance indexes under various shock intensities (in mA): number of reinforcements, number of responses on food key, number of responses per reinforcement, overall response rate on food key (responses per minute), number of resets of progressive-ratio schedule, and number of timeouts. First value in each cell is mean of final five sessions; second entry in parentheses is range of values for these sessions.

<i>Shock Intensity</i>	<i>Reinforcements</i>	<i>Responses</i>	<i>Responses per Reinforcement</i>	<i>Response Rate</i>	<i>Resets</i>	<i>Timeouts</i>
Subject B-24						
0	40 (0)	2012 (10)	50 (0.3)	119 (7)	39 (0)	0.2 (1)
2	40 (0)	2020 (52)	51 (1)	109 (9)	39 (0)	0.0 (0)
4	40 (0)	2102 (158)	53 (4)	95 (25)	38 (2)	0.0 (0)
6	40 (0)	2099 (89)	52 (2)	91 (29)	38 (2)	0.0 (0)
8	40 (0)	2219 (458)	56 (10)	83 (29)	37 (3)	0.0 (0)
10	40 (0)	2187 (207)	55 (5)	88 (19)	37 (3)	0.0 (0)
12	40 (0)	2178 (146)	55 (5)	77 (22)	37 (2)	0.0 (0)
14	37 (10)	5760 (3878)	156 (130)	85 (36)	11 (17)	9.8 (17)
15	15 (11)	3797 (3099)	253 (123)	39 (41)	1 (2)	6.0 (9)
16	8 (1)	2137 (506)	267 (43)	22 (5)	0 (0)	6.6 (8)
0	40 (0)	2011 (7)	50 (0.2)	149 (11)	39 (0)	0.0 (0)
Subject B-33						
0	40 (0)	2361 (193)	59 (5)	118 (3)	33 (4)	0.0 (0)
2	40 (0)	2268 (426)	57 (11)	110 (21)	35 (7)	0.0 (0)
4	40 (0)	2117 (230)	53 (6)	109 (9)	37 (4)	0.2 (1)
5	37 (9)	3476 (675)	94 (39)	32 (8)	22 (8)	2.6 (4)
6	25 (5)	2693 (1368)	108 (53)	25 (11)	10 (8)	3.4 (3)
7	17 (11)	1718 (1389)	101 (86)	16 (10)	8 (11)	3.0 (4)
8	11 (6)	1633 (1452)	148 (96)	15 (14)	3 (4)	2.4 (4)
9	9 (4)	2009 (1229)	223 (121)	16 (11)	0.4 (1)	1.4 (4)
0	40 (0)	2398 (247)	60 (6)	124 (6)	32 (4)	0.0 (0)
Subject B-62						
0	40 (0)	2008 (10)	50 (0.2)	207 (8)	39 (0)	0.0 (0)
2	40 (0)	2006 (7)	50 (0.2)	212 (17)	39 (0)	0.0 (0)
4	40 (0)	2192 (300)	55 (8)	173 (29)	36 (4)	0.2 (1)
6	40 (0)	2192 (154)	55 (4)	169 (22)	36 (3)	0.0 (0)
8	40 (0)	2061 (263)	52 (7)	135 (27)	38 (4)	0.0 (0)
10	40 (0)	2040 (104)	51 (3)	140 (20)	38 (2)	0.0 (0)
12	39 (3)	6326 (2107)	162 (53)	95 (35)	9 (2)	3.2 (6)
13	15 (7)	4210 (1532)	281 (95)	47 (14)	0.6 (1)	9.2 (6)
14	10 (9)	2358 (2566)	236 (75)	27 (23)	0.2 (1)	10.8 (10)
0	40 (0)	2004 (4)	50 (0.1)	190 (11)	39 (0)	0.0 (0)

produced timeouts during the first step, and all pigeons frequently produced timeouts during the second step. This contrasts with the absence of timeouts during these steps under the preliminary condition in which the food key and timeout key were available. The graphs in the bottom row show the mean number of timeouts during each progressive-ratio step, which take account of the fewer opportunities for a timeout response in the longer steps. Those steps with the highest mean number of timeouts were located in the latter half of the progressive-ratio sequence. These functions show marked divergences

from a regularly increasing trend, which could reflect the limited data available for the longer steps. For example, the data point for the longest step completed by each pigeon was based on either one or two observations.

When the shock condition was removed, all pigeons approximated their pre-shock performances within 16 sessions. Table 3 lists some measures of these transitional performances up to the session when recovery was largely complete. The tenth through sixteenth sessions for B-33, during which the overall response rate on the food key continued to increase, were not included. These data show that all

Fig. 3. Cumulative response records of B-24 showing performances under the three highest shock levels. Format of records same as in Figure 1. A reset of the progressive-ratio schedule is indicated by the reset of the response pen and the event marker deflection. Chart speed was 30 cm/hr. Complete sessions are shown. No resets occurred under 16 mA.

pigeons stopped responding on the timeout key while other aspects of the performance were still approaching pre-shock levels. The production of timeouts continued to be related to completion of longer progressive-ratio steps. The cumulative response records for B-24 in Figure 5 illustrate the main temporal features of these transitional performances. These records show that when the pigeon started to reset the progressive-ratio schedule frequently in a session, the completions of longer progressive-ratio steps were limited to the beginning of the session. Any further timeouts were restricted to these longer steps.

The different schedule for illumination of the reset key used for B-33 resulted in a much larger number of superfluous reset-key responses under no-shock and low shock levels relative to the number of these responses by B-24 and B-62. The mean number of these responses in no-shock sessions was 24 for B-33 and one and four for B-24 and B-62 respectively.

DISCUSSION

In different parts of the study, the timeout period functioned as a punishing or as a

Fig. 4. The upper row of graphs presents the total number of reinforcements under each step of the progressive-ratio schedule, the middle row of graphs show the total number of timeouts during each step, and the lower row of graphs shows the number of timeouts per reinforcement at each step. Each point based on the combined data from the final five sessions under the three highest shock intensities.

reinforcing event. The different timeout functions were related to the rate of food reinforcement. When low shock levels were scheduled on the reset key, the rate of food reinforcement was high, approximately two per minute, due to the high overall response rate on the food key and the frequent resetting of the progressive-ratio schedule. A 3-min timeout decreased the overall reinforcement rate and greatly lengthened the time to the next reinforcement. This response-contingent effect classified the timeout as a punishing event (*e.g.*, Holz, Azrin, and Ayllon, 1963; McMillan, 1967). Under high shock levels, the pigeon completed longer progressive-ratio steps and often paused for extended periods; so, a timeout did not necessarily affect the resultant low overall reinforcement rate nor the interreinforcement time.

Thus, the aversive property of the timeout period generated by responding under low shock levels was eliminated by the behavior that developed under the high shock levels.

The changing likelihood of timeouts can be analyzed further by considering other relationships among the controlling variables. The progressive-ratio food schedule was the source of the reinforcing consequences of the reset-key responses and the timeout-key responses. Reset responses produced a more favorable schedule of food reinforcement and were integrated into the progressive-ratio performance; timeout responses lowered the rate of food reinforcement and this became an aversive but avoidable aspect of the environment. As noted previously, intense punishment of reset responses changed these relationships. The subsequent

Table 3

Indexes of performance after removal of shock: number of timeouts, number of resets of progressive-ratio schedule, mean number of responses on food key per reinforcement, and overall response rate on food key (responses per minute).

<i>Session</i>	<i>Reinforcements</i>	<i>Timeouts</i>	<i>Resets</i>	<i>Responses per Reinforcement</i>	<i>Response Rate</i>
Subject B-24					
1	7	9	0	245	19
2	9	4	0	299	25
3	9	6	0	298	26
4	10	2	0	275	24
5	15	2	1	218	29
6	11	4	0	301	31
7	40	1	26	95	91
8	40	0	32	95	74
9	40	0	38	52	158
Subject B-33					
1	7	4	0	200	14
2	22	2	17	98	19
3	40	0	32	63	57
4	40	0	35	57	49
5	40	0	39	56	32
6	40	1	37	58	45
7	40	1	33	65	87
8	40	0	34	57	101
9	40	0	36	55	99
Subject B-62					
1	9	12	0	257	26
2	7	17	0	208	19
3	14	11	1	207	34
4	7	19	0	206	21
5	40	0	34	66	140
6	40	0	39	50	206

progressive-ratio performance not only eliminated the aversive property of the timeout period but also created less favorable conditions of food reinforcement, which is one of the correlates of response-produced timeouts from positive reinforcement. The conditions favoring timeouts would persist until reset responses were completely suppressed and the progressive-ratio schedule no longer maintained responding. At this point, timeouts would be unlikely because their reinforcing properties were dependent on conditions generated by responding under the progressive-ratio food schedule.

Earlier work has shown an increase in the number of response-produced timeouts from positive reinforcement as the reinforcement conditions become less favorable under fixed-ratio schedules (Appel, 1963; Azrin, 1961; Thompson, 1964, 1965) and, to a lesser degree, under a progressive-ratio schedule (Dardano,

1973). Under fixed-interval schedules of reinforcement, however, the relationship between number of timeouts and size of the interval was bitonic (Brown and Flory, 1972). The different functions under ratio and interval schedules could reflect a more abrupt loss of control by ratio schedules. For example, elapsed time without responding increases the proximity of reinforcement under interval schedules but not under ratio schedules.

Previous interpretations of response-produced timeouts from positive reinforcement can be applied to the results of the present study. Under intense shock, the behavioral options of executing a severely punished reset response or of completing a longer response sequence could negatively reinforce the timeout response (Azrin, 1961). Timeout responding also could be explained by the weaker control of the food reinforcement schedule resulting from the increased response require-

Fig. 5. Cumulative response records of B-24 from four complete sessions after the shock condition was removed. Format of the records is the same as in Figure 3. Chart speed was 30 cm/hr. The circled number in front of each record is the number of the session, starting with the first session without shock. In the record for Session 5, the arrow indicates the first reset response.

ment and the associated lower rate of reinforcement (Zimmerman and Ferster, 1964). The weaker schedule control would permit lower probability behaviors, one of which would be responses on the timeout key. A difficulty with these interpretations is that both are predicated on unfavorable reinforcement conditions and both predict timeout responses having the same temporal characteristics. In addition, explanations of response-produced timeouts should deal with the question of subjects responding on the timeout key to eliminate visual stimuli rather than adopting a location and posture in the chamber which would have the same effect. One pertinent factor might be the activity level induced by the food deprivation state, which would rule against an ex-

tended period of inactivity when the food schedule still exerted some control. Also relevant is the finding that pigeons preferred a blackout condition to a stimulus correlated with nonreinforcement (Rilling *et al.*, 1969).

The occurrence of timeouts did not result in any obvious differences in the temporal pattern of the progressive-ratio performance from that seen in an earlier study using the same procedure except for the timeout option (Dardano, 1968). The intrusion of a timeout could change the temporal relations among the controlling stimuli, but such an effect was mitigated by the localization of timeouts in the initial part of the progressive-ratio step where maximum variation in the response pattern was present.

REFERENCES

- Appel, J. B. Aversive aspects of a schedule of positive reinforcement. *Journal of the Experimental Analysis of Behavior*, 1963, 6, 423-428.
- Azrin, N. H. A technique for delivering shock to pigeons. *Journal of the Experimental Analysis of Behavior*, 1959, 2, 161-163.
- Azrin, N. H. Timeout from positive reinforcement. *Science*, 1961, 133, 382-383.
- Brown, T. G. and Flory, R. K. Schedule-induced escape from fixed-interval reinforcement. *Journal of the Experimental Analysis of Behavior*, 1972, 17, 395-403.
- Dardano, J. F. Reversal of preference under progressive-ratio schedules by punishment. *Journal of the Experimental Analysis of Behavior*, 1968, 11, 133-146.
- Dardano, J. F. Self-imposed timeouts under increasing response requirements. *Journal of the Experimental Analysis of Behavior*, 1973, 19, 269-287.
- Falk, J. L. The nature and determinants of adjunctive behavior. *Physiology and Behavior*, 1971, 6, 577-588.
- Ferster, C. B. and Skinner, B. F. *Schedules of reinforcement*. New York: Appleton-Century-Crofts, 1957.
- Findley, J. D. Preference and switching under concurrent scheduling. *Journal of the Experimental Analysis of Behavior*, 1958, 1, 123-144.
- Gentry, W. D. Fixed-ratio schedule-induced aggression. *Journal of the Experimental Analysis of Behavior*, 1968, 11, 813-817.
- Holz, W. C., Azrin, N. H., and Ayllon, T. Elimination of behavior of mental patients by response-produced extinction. *Journal of the Experimental Analysis of Behavior*, 1963, 6, 407-412.
- Leitenberg, H. Is timeout from reinforcement an aversive event? A review of the experimental evidence. *Psychological Bulletin*, 1965, 64, 428-441.
- McMillan, D. E. A comparison of the punishing effects of response-produced shock and response-produced timeout. *Journal of the Experimental Analysis of Behavior*, 1967, 10, 439-449.
- Rilling, M., Askew, H. R., and Ahlskog, J. E. Aversive properties of the negative stimulus in a successive discrimination. *Journal of the Experimental Analysis of Behavior*, 1969, 12, 917-932.
- Sidman, M. Timeout from avoidance as a reinforcer. *Journal of the Experimental Analysis of Behavior*, 1962, 5, 423-434.
- Thompson, D. M. Escape from S^D associated with a fixed-ratio reinforcement schedule. *Journal of the Experimental Analysis of Behavior*, 1964, 7, 1-8.
- Thompson, D. M. Timeout from fixed-ratio reinforcement: a systematic replication. *Psychonomic Science*, 1965, 2, 109-110.
- Verhave, T. An adjusting fixed-ratio schedule for a timeout from avoidance. *Journal of the Experimental Analysis of Behavior*, 1959, 2, 253.
- Verhave, T. The functional properties of a timeout from an avoidance schedule. *Journal of the Experimental Analysis of Behavior*, 1962, 5, 391-422.
- Zimmerman, J. and Ferster, C. B. Some notes on timeout from reinforcement. *Journal of the Experimental Analysis of Behavior*, 1964, 7, 13-19.

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