CONDITIONING HISTORY AND THE CONTROL OF HUMAN AVOIDANCE AND ESCAPE RESPONDING¹

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Inter-subject differences in response rates under free-operant avoidance and escape schedules are commonly obtained from humans. Data are presented which demonstrate that such differences can be controlled experimentally by giving subjects different conditioning histories. Subjects given a fixed-ratio history avoided and/or escaped from "point-loss periods" at higher rates than subjects given a differential-reinforcement-of-low-rates history. History related differences in response rates were maintained during 40 hr of escape responding. For low-rates history subjects, response rates under escape contingencies decreased as the rate of point-loss periods decreased.

Inter-subject variability has been particularly marked under simple interval schedules of reinforcement (Weiner, 1969). An example is human operant responding under avoidance and/or escape contingencies. Marked inter-subject differences in response rates have been reported with humans under free-operant avoidance and escape schedules employing either electric shock (Ader and Tatum, 1961; Davidson and Kirkwood, 1968; Stone, 1961), loss of money (Stone, 1961), or loss of points (Weiner, 1963*b*, 1964*a*) as aversive stimuli. To illustrate the severity of the problem, Stone (1961) found that inter-subject differences in response rates under free-operant avoidance schedules with humans exceeded response rate differences that resulted from either utilization of different types of aversive stimuli (electric shock *vs* loss of money) or manipulation of the time each response postponed aversive stimuli (the R-S interval).

Weiner (1964*b*, 1965, 1969) showed that individual differences in response rates under fixed-interval (FI) and variable-interval (VI) schedules can be controlled by providing subjects with different histories of conditioning. Subjects trained initially (given a conditioning history) under a fixed-ratio 40 (FR 40) schedule responded at relatively high constant

rates under subsequent FI and VI schedules; low FI and VI response rates were obtained from subjects with a history under a 20-sec differential-reinforcement-of-low-rate (DRL 20-sec) schedule.

The present experiment attempted to ascertain whether FR 40 and DRL 20-sec histories can also be used to control inter-subject differences in response rates under avoidance and/or escape schedules.

METHOD

Subjects

Male and female psychiatric nursing assistants were paid by the hour only, at rates of from \$2.50 to \$4.00 depending upon their salary level as nursing assistants.

Apparatus, Task, Instructions

The experimental apparatus, task, and instructions were the same as those described previously (Weiner, 1969). Briefly, subjects were instructed to press a microswitch response button to make a counter add as many points and subtract as few points as possible. They were told nothing about the purpose of the experiment, the nature of the experimental conditions, or at what rate to press the response button. An effective response required a force of approximately 20 g through a distance of 1 cm.

Transistorized digital equipment was used to schedule experimental contingencies (Weiner, 1963*a*). Responses were recorded contin-

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uously on a Gerbrands cumulative recorder and electro-mechanical counters.

Procedure

Subjects responded initially (were given a history) under either an FR 40 schedule or a DRL 20-sec schedule. Under FR 40, every fortieth button-press was reinforced by the addition of 100 points to the subject's score on the counter. Under the DRL 20-sec history schedule, subjects could obtain 100-point additions only by spacing two successive responses by at least 20 sec. A response emitted before 20 sec had elapsed from the immediately preceding response delayed the next 100-point reinforcement for at least 20 sec.

Distinctive lights were associated with the FR 40 and DRL 20-sec history schedules and with the avoidance-escape, avoidance, and escape schedules to be described later. Subjects received ten, 1-hr sessions under each schedule.

Phase 1

Subjects were divided into three groups with three FR 40-history subjects and three DRL 20-sec-history subjects in each group. One group was conditioned on a 10-sec avoidance-escape (AvEs 10-sec) schedule. A second group was conditioned on a 10-sec avoidance (Av 10-sec) schedule. The third group was conditioned on a 10-sec escape (Es 10-sec) schedule.

Under the AvEs 10-sec schedule, a 20-sec "point-loss period" (PLP), during which 100 points were subtracted from the score on the counter at the rate of five points per second, was scheduled every 10 sec unless the subject pressed the button. Each button-press emitted within 10 sec from either a previous button-press or the termination of a PLP postponed the next PLP for 10 sec. A button-press emitted after the onset of a PLP, terminated the PLP for 10 sec. Beyond a mandatory five-point loss per PLP, the number of points lost during a PLP depended upon the latency of the escape response (*i.e.*, the time interval between the onset of a PLP and the escape response). Thus, under the AvEs 10-sec schedule, the subjects were able either to avoid (postpone for 10 sec) or escape (terminate for 10 sec) PLPs. Under the Av 10-sec schedule, subjects could avoid but not escape PLPs. Under the Es 10-sec schedule, subjects could escape but

not avoid PLPs. All other contingencies under Av 10-sec and Es 10-sec were the same as those described for the AvEs 10-sec schedule.

Phase 2

Four FR 40- and four DRL 20-sec-history subjects were conditioned in succession under these escape contingencies: Es 10-sec, Es 30-sec, Es 60-sec, Es 300-sec. The Es 10-sec schedule was the same as the one used in Phase 1. The other escape contingencies were the same as Es 10-sec, except for the differences in inter-PLP intervals.

RESULTS

Phase 1

Average response rates under the FR 40 and DRL 20-sec history schedules and average response rates and point losses during the subsequent AvEs 10-sec, Av 10-sec, and Es 10-sec schedules are presented in Table 1. Final response rates (Sessions 7 to 10) were higher under FR 40 than under DRL 20-sec. The FR 40-history subjects maintained markedly higher response rates than DRL 20-sec-history subjects during Sessions 1 to 6 and 7 to 10 under the AvEs 10-sec, Av 10-sec, and Es 10-sec schedules.

History related differences in response rates were not a simple function of point losses during Sessions 1 to 6 and 7 to 10 under the AvEs 10-sec and Es 10-sec schedules and during Sessions 1 to 6 under the Av 10-sec schedule. Only during Sessions 7 to 10 under the Av 10-sec schedule did FR 40-history subjects have higher response rates and consistently fewer point losses than DRL 20-sec-history subjects.

Inspection of the changes in response rates and point losses from Sessions 1 to 6 to Sessions 7 to 10 under the three avoidance and/or escape schedules in Table 1 suggests also that response rates and point losses were not a simple function of one another. Whereas the response rates of the FR 40 and DRL 20-sec-history subjects did not change in a consistent direction from Sessions 1 to 6 to 7 to 10, all subjects lost fewer points during Sessions 7 to 10 than during Sessions 1 to 6 under the AvEs 10-sec, Av 10-sec, and Es 10-sec schedules.

Figure 1 presents the tenth-session performances of a subject under FR 40 and a subject under DRL 20-sec as well as their respective subsequent performances under the

Table 1

Average response rates per minute under the FR 40 and DRL 20-sec history schedules and average response rates per minute and average points lost per session under the subsequent AvEs 10-sec, Av 10-sec, and Es 10-sec schedules.

Subjects	History Schedules Average Resp/Min Sessions	Aversive Schedules			
		Average Resp/Min Sessions		Average Pts Lost/Sess Sessions	
		1-6	7-10	1-6	7-10
	FR 40	Av Es 10-sec			
71	420	319	402	27	5
414	370	209	250	3132	0
86	353	179	195	755	21
	DRL 20-sec				
88	4	15	14	39	1
479	3	32	17	4064	15
87	2	15	20	452	6
	FR 40	Av 10-sec			
89	609	584	550	550	0
90	360	171	165	1116	25
68	278	195	208	733	100
	DRL 20-sec				
94	5	10	12	2266	1325
95	2	116	90	800	150
96	2	11	15	966	150
	FR 40	Es 10-sec			
70	300	407	386	1888	1883
82	300	286	274	1808	1800
130	227	295	265	2588	2375
	DRL 20-sec				
74	4	9	10	2680	1901
84	3	7	7	1898	1821
83	3	44	49	3267	2109

AvEs 10-sec schedule. Of interest is the fact that the FR 40-history subject (414) responded at a relatively high constant rate during the tenth session under the AvEs 10-sec schedule, despite the fact that he had avoided all PLPs at a much lower rate during the third session. Also, the DRL 20-sec-history subject (479) responded at a relatively low rate during the tenth session under AvEs 10-sec, even though he had received fewer PLPs by responding at a higher rate during the sixth session. It appears that the tenth-session performances of these subjects under the AvEs 10-sec schedule were not due simply to differential reinforcement of response rates in earlier sessions.

The data in Table 1 and Fig. 1 suggest that rates of responding under the aversive schedules during Sessions 7 to 10 were more related to response rates established under the differ-

ent history schedules than to point losses or differential reinforcement of response rates during the course of aversive conditioning.

Additional findings, which do not appear in Table 1 or Fig. 1, may be mentioned. First, all three FR 40-history subjects responded at fairly constant rates between PLPs under the Es 10-sec schedule. In contrast, all three of the DRL 20-sec-history subjects exhibited post-PLP pausing under the Es 10-sec schedule. Second, FR 40-history subjects maintained high rates of relatively constant responding under the Es 10-sec schedule, despite the fact that a small number of PLPs occurred and were terminated after periods of no responding. Finally, session-to-session response rates under the AvEs 10-sec, Av 10-sec, and Es 10-sec schedules provided no clear evidence that history related differences in response rates

Fig. 1. Final (tenth session) performances of a subject (414) under FR 40 and a subject (479) under DRL 20-sec and their subsequent performances under the AvEs 10-sec schedule. Vertical marks on the records under the FR 40 and DRL 20-sec schedules indicate the occurrence of 100-point reinforcements. For the AvEs 10-sec records, the recording pen was displaced downward after onset of a PLP (point-loss period). While displaced, the pen continued to make a cumulative record of responses. The pen reset after termination, either by the subject or the scheduling equipment, of the PLP.

were transitory; response rates did not appear to be changing in a systematic direction during the final four sessions under the three avoidance and/or escape schedules.

Phase 2

Figure 2 presents average response rates per session for each subject under the different history and escape schedules. The FR 40-history subjects responded at higher rates than the DRL 20-sec-history subjects throughout the 40 hr of escape conditioning. Response rates were reasonably stable during Sessions 7 to 10 under each of the four escape schedules.

Figure 2 shows that the final (Sessions 7 to 10) response rates of all DRL 20-sec-history subjects were related to the inter-PLP intervals under the escape schedules; response rates decreased as inter-PLP intervals increased. The final response rates of the FR 40-history subjects did not change in a consistent fashion when inter-PLP intervals changed.

DISCUSSION

In the absence of any scheduled conditioning history, marked inter-subject differences in response rates are commonly obtained from humans under avoidance-escape, avoidance, and escape schedules (*e.g.*, Stone, 1961; Weiner, 1963*b*). The present experiment demonstrated that inter-subject differences in avoiding and/or escaping from "point-loss periods" (PLPs) may be produced experimentally and hence controlled by providing subjects with different histories of conditioning. Subjects given an FR 40 history produced higher rates of responding under avoidance and/or escape contingencies than subjects given a DRL 20-sec history. This finding is consistent with and extends previous work by Weiner (1964*b*, 1965, 1969) which showed that FR 40-history subjects also respond at higher rates than DRL 20-sec-history subjects under FI and VI schedules.

Fig. 2. Session-to-session response rates under the FR 40 or DRL 20-sec history schedules and under the Es 10-sec, Es 30-sec, Es 60-sec, and Es 300-sec schedules. Note that the graphs for the FR 40 and the DRL 20-sec-history subjects have different ordinate values.

This experiment also showed that history related differences in response rates and patterns under escape schedules may be maintained over considerable periods of time (40 hr). In addition, the likelihood of correlation between response rates and the rate of PLPs under escape schedules was found to depend on the conditioning history of subjects. Unlike FR 40-history subjects, subjects with the DRL 20-sec history showed consistent decreases in response rates under escape contingencies as the rate of PLPs decreased. Similar relationships between response rates and reinforcement rates have been obtained under FI schedules following FR 40 and DRL 20-sec histories (Weiner, 1969).

The finding that response rates and PLP rates under escape schedules were highly correlated only when subjects responded at low rates after DRL 20-sec conditioning is analogous to some results reported by Davidson and Kirkwood (1968). These authors found that human avoidance responding was related to the response-shock intervals only when such responding occurred at low rates.

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