Temporal variables in the acquisition of human free-operant avoidance of "time out"¹

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Human Ss acquired a response on a free-operant avoidance schedule in which "time out" (TO) from monetary reinforcement was the aversive event and various R-TO and TO-TO interval durations were employed. Acquisition was more rapid in groups where the R-TO interval was longer than the TO-TO interval than in groups where the R-TO interval either equalled or was shorter than the TO-TO interval. Differences within these broad groupings were unsystematic. After acquisition, rates of response varied as a function of the R-TO interval.

Baron & Kaufman (1966) demonstrated that "time out" (TO) from monetary reinforcement can effectively maintain the free operant avoidance behavior of human Ss. In this work, a signal of monetary payment was terminated for a fixed period of time at designated intervals (the TO-TO interval). Each response when time was in postponed the next TO for a designated interval (the R-TO interval).

The present experiment used similar procedures to study temporal variables related to acquisition of TO-avoidance. Studies of shock-avoidance have found most rapid acquisition when the R-S interval is considerably longer than the S-S interval (Ader & Scibetta, 1964; Leaf, 1965; Sidman, 1966). To determine whether the same relationship holds for TO-avoidance, acquisition was observed when the R-TO interval was either longer than, shorter than, or equal to the TO-TO interval.

Method

Subjects and Apparatus. The Ss were 42 female college students who answered an advertisement offering a maximum of \$4.50 for one 3 h work period. All professed no prior knowledge of the research.² The apparatus (Baron & Kaufman, 1966) consisted of a 6 ft sq sound attenuated room. On a table in the room was a sloping panel on which were mounted two ground glass screens and a plastic response key.

Procedure. The S was alone in the experimental room, seated before the panel. Tape recorded instructions indicated that: (a) when the right screen was white, the session was in progress; (b) when the left screen was green, payment was at the rate of \$1.50 per h; (c) after 90 min there would be a 10 min rest period. The instructions made sole reference to the response key and responding in the following way: "Notice that there are two glass panels with a round opening between them. There is a button in the opening. Go ahead, touch it. You can see that it moves."

For the first 5 min, and until 3 min had elapsed without a response, the green light appeared continuously and key pressing had no consequence. A

free operant avoidance schedule then was programmed using termination of the green light (accompanied by low intensity white noise) as the aversive event. If the response key was not pressed, 15 sec periods of TO occurred at designated intervals (the TO-TO interval), timed from the end of the preceding TO. Each response when time was in postponed the next TO for a designated interval (the R-TO interval). Responses during the TO period itself had no effect.

Seven groups of six Ss each were exposed to the following combinations of R-TO/TO-TO intervals; (a) R-TO > TO-TO—60/5, 20/2.5, and 20/5 sec; (b) R-TO = TO-TO—20/20 and 5/5 sec; (c) R-TO < TO-TO—20/40 and 2.5/5 sec. Observations were continued for at least 100 min from the time of the first avoidance response, or, in the case of two Ss who made no avoidance responses, for 175 min.

Results and Discussion

Unconditioned responding during the initial phase was infrequent (median = 0). Following exposure to the avoidance schedule, however, substantial rates of avoidance responding developed in the majority of Ss, and all but two made at least some responses.

Rate of acquisition was defined as the time from the first avoidance response to the start of five consecutive 2 min periods when at least 50% of the scheduled TOs were avoided. The two nonresponders were excluded from this and subsequent analyses. The seven R-TO/TO-TO groups did not differ systematically in latency of the first avoidance response (overall median = 8 min; range = 3–50). The first avoidance response usually was preceded by key pressing during the TO period itself.

Figure 1 presents criterion times for individual members of the different groups. Subjects who did

Fig. 1. Acquisition times. Each bar represents an individual subject.

Fig. 2. Response rates following acquisition as a function of the R-TO interval.

not attain the criterion were assigned the value of 100 min, as were a few Ss who acquired the response before the end of the 180 min session but took longer than 100 min. Figure 1 shows considerable variability within each condition with both rapid learners and nonlearners distributed over the range of conditions. However, Fig. 1 also shows that on the average the criterion was reached more rapidly in the three groups where $R\text{-TO} > \text{TO-TO}$ than in the four groups where $R\text{-TO} \leq \text{TO-TO}$ ($U=95$, $n=18/22$, $p < .01$); systematic differences within these broad groupings were absent. With respect to the 11 Ss not attaining the criterion, nine made relatively few responses (range = 2-67), one of these in the 60/5 groups and eight in groups where $R\text{-TO} \leq \text{TO-TO}$. One S (20/20) responded more frequently (639) but fell far short of the criterion. The remaining S (20/5) consistently avoided about 40% of the scheduled TOs.

Avoidance rates for 20 min after the criterion period³ are presented in Fig. 2 as a function of the four R-TO intervals, i.e., 60, 20, 5, and 2.5 sec. Figure 2 shows that avoidance rates tended to increase as a function of decreases in the R-TO interval. Differences between adjacent groups in Fig. 2 are reliable ($p < .05$) except for differences between 2.5 and 5 sec.

Similarities between the present results and those of studies of free operant shock avoidance support the contention that the functional properties of TO parallel those of painful stimuli (cf., Leitenberg, 1965). In addition, the present results, together with

those of other avoidance studies with humans (e.g., Ader & Tatum, 1961; Baron & Kaufman, 1966; Stone, 1961), show the validity for human behavior of principles originally derived from work with animals.

A number of other implications of the results are noted below. (a) Unlike studies using shock, the majority of Ss acquired the response when $R\text{-TO} = \text{TO-TO}$, and when $R\text{-TO} < \text{TO-TO}$, an arrangement usually viewed as particularly unfavorable for free operant shock avoidance. (b) Variability in acquisition times should not be construed as more extreme than variability when shock is the aversive event. Most studies of shock avoidance have used too few Ss to provide information on this question, but the available evidence (Leaf, 1965; Sidman, 1966) also suggests major differences among Ss trained under identical temporal conditions. (c) The present results argue against the hypothesis that acquisition times vary continuously as a function of differences among $R\text{-TO}/\text{TO-TO}$ ratios, since the acquisition times of the three $R\text{-TO} > \text{TO-TO}$ groups were not dissimilar, nor were the times of the four $R\text{-TO} \leq \text{TO-TO}$ groups. However, these results may be an outcome of the variability inherent within the data, or of failure to include the proper $R\text{-TO}/\text{TO-TO}$ combinations, e.g., ratios between 1.00 and 4.00. (d) Rates assumed after acquisition generally followed the same function obtained when individual Ss were given extended training with a number of different $R\text{-TO} = \text{TO-TO}$ intervals (Baron & Kaufman, 1966).

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Notes

1. This research constituted the first author's M. S. thesis and was supported by NSF grant GB 4004.
2. Data from four other Ss were discarded. Two left midway in the experiment, one confessed prior knowledge after completion, and in one case there was an apparatus malfunction.
3. In one case, based on 9 min.