A NOTE ON TIME OUT FROM AVOIDANCE WITH THE CHIMPANZEE[1]

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Fixed-interval responding which produced time out from shock avoidance schedules was established in a chimpanzee. Two widely differing discriminated avoidance schedules were employed in a multiple schedule arrangement. Differences in fixed interval rate were found to be related both to the schedule from which the subject was escaping and to the amount of training.

Behavior which produces a time out from avoidance contingencies (Verhave 1959, Sidman 1962) may be thought of as second-order escape behavior in which the aversive event is a period of shock avoidance. Both Verhave and Sidman have clearly shown that such escape responding can be maintained in rats and monkeys. Furthermore, their work shows the strength of such behavior to be a function of several schedules by which the time out is produced. It is not clear at this time, however, to what extent the behavior is a function of the avoidance parameters from which the animal makes an escape. The present experiment compares fixed interval responding which was associated with, and allowed to escape from, two alternative schedules of avoidance.

METHOD

Subject

A mature, 60 lb. female chimpanzee, previously trained on a Sidman (1953) shock avoidance procedure with the apparatus described below, and on CRF to produce periods of time out served. About a week before the present experiment, the subject was introduced to a discriminated or paced avoidance procedure (described below), and the TO contingency was gradually modified to a 4-hr FI schedule.

Apparatus

A metal-lined chamber, 5 ft square and 8 ft high, contained a metal-covered shelf where the animal could sit to work the avoidance and time out switches. Other switches were worked to obtain food and water (See Fig. 1).

The response switches[3] were industrial push button microswitches mounted in discs of milk plastic illuminated from behind to provide

Fig. 1. The chimpanzee is shown wearing the shock collar in the experimental chamber where it lived throughout the experiment. The shock collar and cable permitted reliable delivery of shocks without further constraining. The shelf and the panel containing the TO and avoidance switches are on the wall at the rear of the chamber.

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[3]Cuttler-Hammer, oil tight, industrial push button switch series #10250T.

discriminative control of the behavior. The chamber also contained overhead lights which were turned on during shock avoidance and off during TO periods. A ringing electric door bell served as an additional stimulus to alert the animal, if asleep, to the start of an avoidance session.

The shock was a brief pulse (0.5 sec, 5-7 ma) supplied by an ac transformer and a current-limiting resistor. Shock was delivered to the animal's neck by a specially designed collar with the metal chamber serving as ground. This collar arrangement (see Appendix) combines minimum restraint and reliable delivery of shock.

Procedure

The animal lived continuously in the experimental chamber with the shock collar connected. Food and water were available at any time by operating switches on the panel.

At the start of each avoidance period, a houselight came on, and the schedule of shock avoidance and requirements for TO were made effective. A door bell also came on to alert the animal, and was turned off by the first avoidance response.

The principal procedure was a schedule of discriminated shock avoidance (described below) programmed concurrently with a 4-hr FI contingency which produced an 8-hr TO period. The avoidance contingency was programmed on one switch, the TO contingency on another. The first response on the TO switch after 4 hr would turn off response switches and lights and the houselights for 8 hr. A 2-sec delay was required between an avoidance response and the production of a TO to eliminate the spurious contingency of a TO immediately following an avoidance response. The two different schedules of shock avoidance (each associated with a colored light) occurred alternately after each TO period.

Avoidance Schedules

To control avoidance rates and minimize interactions with the FI responding, a discriminated or paced avoidance procedure was employed. At the beginning of an avoidance period, the light behind the avoidance switch was off. At the end of an interval (R-L interval) the avoidance light came on and remained on until a response was made. Once the light had appeared and no response occurred, a brief shock was delivered each time an interval equal to the R-L interval was completed. A response in the presence of the avoidance light extinguished this light, reset the R-L interval, and began the cycle again. A response after the light had appeared and before the interval timed out successfully avoided shock. Extra responses on the unlighted avoidance switch reset the R-L interval and delayed the onset of the avoidance light. The interval between a response and a shock (R-S interval) was twice the R-L interval. The interval between successive shocks with no intervening responses (S-S interval) was identical to the R-L interval. Two avoidance schedules were alternated after each 8-hr TO. One schedule employed an R-L interval of 15 min, identified by a white avoidance light, and the other a 15 sec R-L interval identified by a blue avoidance light. The R-S interval in the white light was 30 min and in the blue light, 30 sec.

The experiment lasted approximately two and one-half months and included a period of transition training from Sidman avoidance to the present procedure. The data are from the last 60 experimental days with an average of two avoidance periods per day.

The TO responses and avoidance responses were recorded on a cumulative recorder. In addition, TO responses were recorded separately on a bank of counters by consecutive 48-min periods of the FI.

RESULTS AND DISCUSSION

Figure 2 is a sample daily record (except for the TO periods) taken from the last 20 days. It illustrates observed differences in FI responding depending upon the associated avoidance schedule. The top panel shows performance during the white avoidance period (R-L = 15 min). The lower panel shows performance during the blue avoidance period (R-L = 15 sec). The TO responses (or escape responses under the FI contingency) are recorded cumulatively, the avoidance responses noncumulatively on the event pen below. This sample record illustrates the high FI response rate found with the short avoidance and the lower FI rate associated with the longer avoidance interval. The avoidance rates were always considerably below the FI rates. The ap-

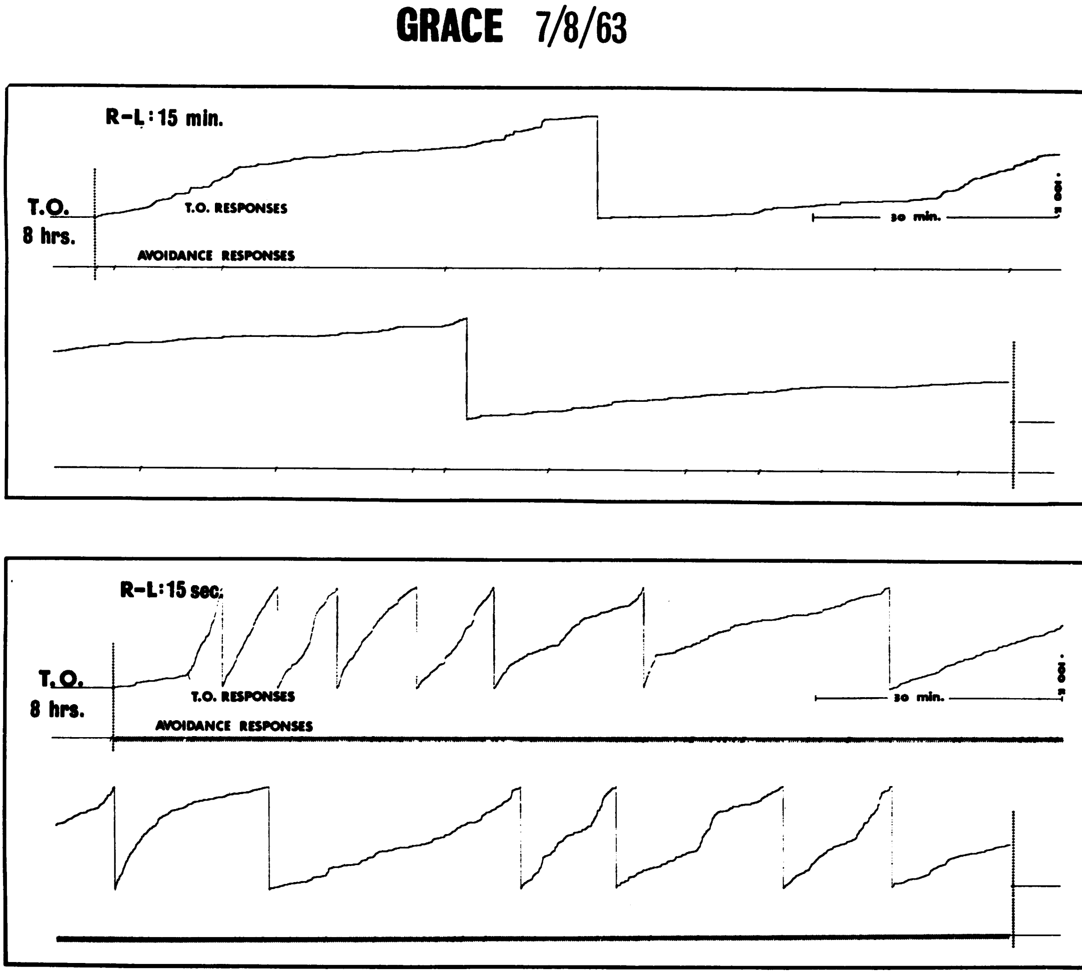

Fig. 2. A sample record showing cumulative TO responses during a 4-hr fixed interval to escape from two avoidance baselines. The top panel shows the performance associated with a 15 min R-L interval; the lower shows performance associated with a 15 sec R-L interval. The avoidance responses are shown on an event pen and shocks are indicated by oblique pips on the cumulated TO responses.

pearance of bursting on the avoidance switch was produced by only a few extra responses and is exaggerated by the slow paper speed.

Figure 3 presents, for the total experiment, the mean response rate on the 4-hr FI schedule to obtain a TO from each of the two associated schedules of shock avoidance. The 4-hr FI has been broken down into five consecutive time periods to show changes of response rate within the FI. The data have been plotted separately by groups of 20 days to show performance changes with respect to the amount of training.

Figure 4 shows the number of shocks received in each of the two avoidance baselines in blocks of five days for the entire experiment.

Several findings are suggested by Fig. 3 and 4. First, the TO rates are clearly higher for the shorter avoidance interval than for the longer one. Secondly, these differences in TO rate tend to diminish with continued training. Thirdly, the rate of TO responding in both cases is negatively accelerated within the FI during the training observed. Interpretations of these results rest upon several considerations. First, it should be noted that the TO rates for the short avoidance exceed 4.0 resp/min in all cases, and for the longer avoidance, always exceed 0.06 resp/min. These rates are the respective stimulus presentation rates associated with each avoidance schedule. The avoidance response rates closely approximated the rates of stimulus presentation, which is consistent with Sidman (1955) and Ulrich, Holz, and Azrin (1964). Hence, the finding of TO rates higher than avoidance rates indicates that the escape responding is not likely to be a simple induction effect from the corresponding avoidance responding. Also, since the avoidance rates were generally low, it seems that there was a minimum of carry-over from the animal's history with Sidman avoidance.

Regarding the first finding, it appears that a shorter avoidance interval will generally support a higher TO rate of escape. The second finding—that the effect diminished with continued training—considerably complicates the matter and is not adequately explained by the data at hand. One possibility is that the difference in aversiveness of the two avoidance schedules diminishes due to the low overall frequency of shock (0.08 shocks per hr) received during the total experiment. Figure 4, however, indicates no systematic decrease in the number of shocks received in the two avoidance schedules; the daily records, such as Fig. 2, clearly showed the shocks to be effective throughout. A more likely possibility is that the decline in TO responding indicates a partial discrimination of the FI contingency which permits the onset of the TO period to be relatively independent of the response rate within the FI. Although the lack of positive acceleration during the FI does not support such a discrimination, both Kaplan (1952) and Verhave (1962) have noted a lack of FI scalloping in escape situations. Cook and Ca-

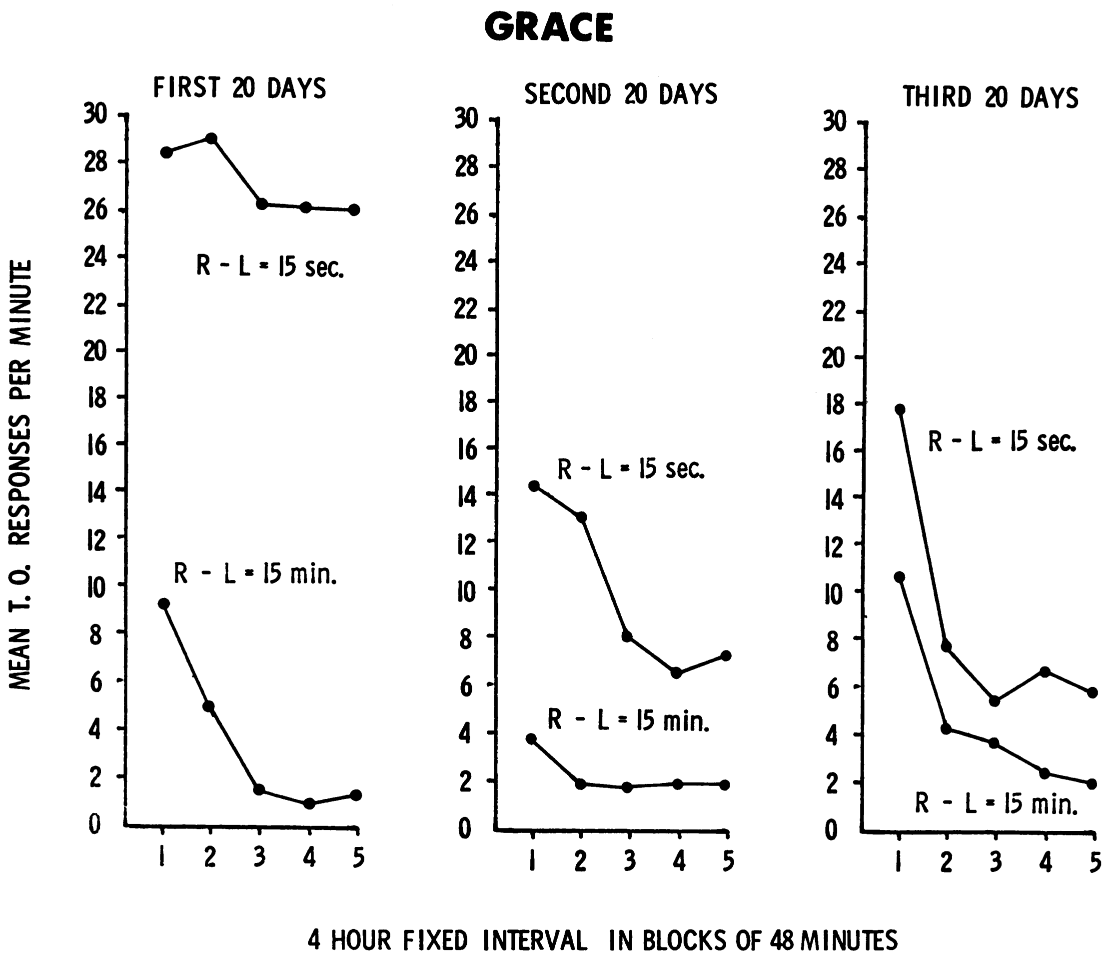

Fig. 3. The mean rate of responding to obtain an 8-hr TO from two different avoidance schedules is shown with respect to successive 48-min segments of a 4-hr FI escape contingency. The data are presented by consecutive groups of 20 experimental days to show changes in the TO performance during the experiment.

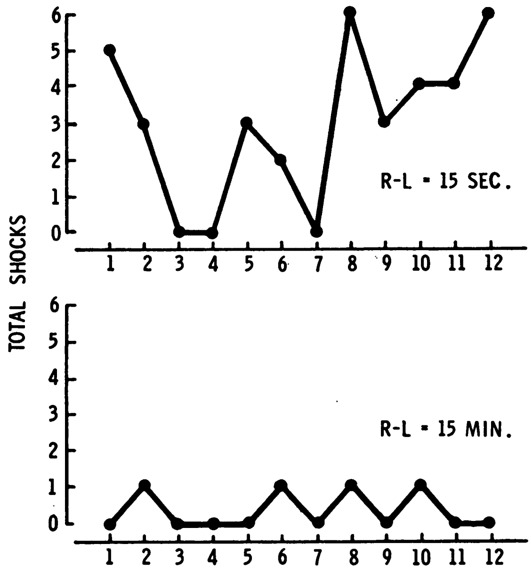

Fig. 4. The number of shocks received in each avoidance baseline is shown in blocks of five days. The number of shocks received in the blue avoidance (R-L = 15 sec) is shown in the upper curve; shocks received in the white avoidance (R-L = 15 min) in the lower curve.

tania (1964) and Kelleher and Morse (1964), on the other hand, have found evidence of FI scallops with negative reinforcements. The unusually long FI (4 hr) used here may help to explain the lack of FI scallops. The lack of scalloping, however, would not completely rule out the possibility of some discrimination of the contingency.

The present experiment, then, suggests that within limits, a shorter avoidance contingency will support larger amounts of responding to produce a TO. Unanswered, however, are several interesting questions, such as the possible interaction between the aversiveness of an avoidance baseline and the kind of contingencies for escape. For example, a fixed ratio escape contingency may facilitate escape behavior more with increasingly aversive avoidance baselines than would other escape contingencies in which the production of a TO is not directly related to the magnitude of the behavior output. In schedules without a direct relationship between the escape behavior and the TO, the aversiveness and resultant emotionality may work against the formation of discriminations necessary for effective escape behavior. The commonly supposed weakness of higher order escape behavior may rest only with inadequate assessment of the exact contingencies for escape, and with the immediate, but short term success of various avoidance behaviors. In any event, the general analysis of aversive control would seem far from complete without greater study of behaviors only indirectly tied to an ultimate aversive event.

APPENDIX

The shock collar is formed from two strips of 1/16 in. belt blank leather enclosing a band of spring steel.[4] The inside strip of leather is riveted to the spring steel so that the rivets can conduct to the animal's neck. A metal staple from a door hasp is riveted to one end of the spring steel band. The other end is slotted so that the ends of the collar can be joined together. The collar was sewn together by a local shoe repairman, trimmed, and softened with saddle soap.

The cable which supplied the shock was 3/32-in. nyclad tiller cable protected with a length of 9/16-in. inside diameter Aeroquip series 601 stainless steel shielded high pressure hose. The end of the hose was fitted with a 1/2-in. nylon hose-to-pipe fitting secured by a Band-it hose clamp. The plastic covered tiller cable was knotted to prevent it being pulled out of the armored cable, and then was passed through a pipe cap with a hole cut in its end. The end of the tiller cable was then stripped of its plastic coating and looped through a brass swivel and secured with a Nico press cable clamp. The swivel was guarded with a 2½-in. plastic disc which prevented it from shorting against the side of the cage. The other side of the swivel was then connected to the collar staple by a small padlock.

[4]The design and construction of this collar by Bill Love is gratefully acknowledged.

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