Acquisition of passive avoidance in rats*

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Shock was administered after allowing Ss to move from the safe to the shock compartment (response contingent) or after direct placement into the shock compartment. Half of the Ss in each group were allowed to escape the shock by running into the safe compartment, and the other half had the shock terminated in the shock compartment (inescapable). Testing for passive avoidance showed that response-contingent shock produced much better passive avoidance than did placed shock, but there were no differences due to the escapable-inescapable shock manipulation.

Several different procedures are available to the E wishing to produce passive avoidance behavior. Using a two-compartment box, the S can be directly placed in the shock compartment and given shock or it can be placed in the safe compartment and allowed to enter the shock compartment where it is then shocked. These manipulations are characterized as "placed shock" or "response-contingent shock," respectively. Once the S receives shock, the shock can simply be terminated while the S is still in the shock compartment, or the S may be allowed to escape from the shock by running into the safe compartment. These manipulations are characterized as "nonescapable shock" or "escapable shock," respectively. In this experiment, these manipulations were combined in a 2 by 2 factorial design to assess their effectiveness in producing passive avoidance behavior.

Calhoun & Murphy (1969) used similar manipulations in mice and found response-contingent shock to be the most effective condition regardless of the escape-nonescape manipulation. Unfortunately the testing period used for assessing the degree of passive avoidance was too short to determine if differences might have existed between response-contingent groups receiving escapable shock and those receiving nonescapable shock (i.e., very few of the Ss receiving response-contingent shock entered the shock compartment in the 5-min test period). In addition, no attempt was made to control the duration of shock across groups, and differential shock durations across groups were not reported. It should also be noted that sometimes differences between response-contingent and placed shock are not evident (Blanchard & Blanchard, 1968).

Thus, the present experiment was performed (1) to determine the generality of the Calhoun & Murphy (1969) data using rats as Ss, (2) to explore possible differences across groups with extended testing, and (3) to control the total duration of shock by using a yoked control procedure.

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METHOD

Subjects

A total of 24 male albino rats of the Sprague-Dawley strain, approximately 110 days old, obtained from the Holtzman Co., Madison, Wisconson, served as Ss.

Apparatus

A wooden box that was painted black and had a hardware cloth top and grid floor was used. The inside dimensions of the box were 90 cm long, 14 cm wide, and 30 cm deep. The grid floor consisted of aluminum tubes, 13 mm in diam and spaced 4 cm center-to-center. The box was divided into two compartments by a clear Plexiglas guillotine door. The safe compartment was 22 cm long, and the shock compartment was 68 cm long. A Grason-Stadler shocker (Model 700) was used to deliver scrambled shock of 1.0 mA (nominal setting). A stopwatch, which read to the nearest .1 sec, and a mechanical counter were also used.

Procedure

The design of the experiment was a 2 by 2 factorial. Acquisition of passive avoidance was tested following a response-contingent shock or a placement shock and escape or nonescape from the shock. In the response-contingent condition, S was placed in the safe compartment with the guillotine door down, and 5 sec later the door was opened. When S crossed over to the shock side, the door was lowered and the shock was delivered. In the placed condition, the S was placed directly in the shock compartment and 5 sec later the shock was delivered. In the escape condition, the shock was delivered for 5 sec with the guillotine door down, and then the door was raised, allowing S to escape the shock by running into the safe compartment. In the no-escape condition, a minimum of 5 sec of shock was delivered, but the shock could not be terminated by escaping to the safe compartment (i.e., the guillotine door remained closed). Combining these conditions produces four groups of Ss. Group RC-E received the response-contingent shock and was allowed to escape. Group RC-NE also received a response-contingent shock, but was not allowed to escape. The duration of shock for the RC-NE group was yoked to the duration of shock experienced by the RC-E group by pairing Ss. Group P-E received a shock after being placed in the shock compartment and was allowed to escape to the safe compartment. Group P-NE was also placed in the shock compartment, but was not allowed to escape to the safe compartment. The duration of shock for the P-NE group was yoked to the duration of shock for the P-E group by pairing Ss.

All Ss received one acquisition trial, and the minimum shock duration was 5 sec. Two 15-min tests followed the acquisition trial, one by 24 h and the second by 48 h. In the test session, the S was placed in the safe compartment and the door was raised after 5 sec. The three measures of passive avoidance were: (1) initial exit latency, (2) time in shock compartment, and (3) number of crossings between the safe and shock compartments. The criterion for exiting from the safe area was that the S must have its backpaws on the third bar into the safe area.

RESULTS

The data from the three different measures all tended

Table 1
Mean Measures of Passive Avoidance Behavior Over the Two Testing Sessions for Each Group

Measure of Passive Avoidance	Experimental Condition			
	RC-E	RC-NE	PE	P-NE
Initial Exit Latency (Min)	23.25	16.17	4.10	6.52
Number of Exits	4.67	11.50	16.83	13.67
Time in Shock Compartment (Min)	1.50	6.10	13.77	8.37

to reflect the same conclusion—the response-contingent manipulation was more important in producing passive avoidance than was the escape manipulation. The analysis of initial exit latencies indicated a significant effect due to response contingent ($F = 18.44$, $df = 1/20$, $p < .001$), but no significant effect due to the escape manipulation ($F = .50$, $df = 1/20$) or in the interaction of the two variables ($F = 2.03$, $df = 1/20$). The mean initial exit latencies are shown in Table 1; they show stronger passive avoidance (greater fear) for the Ss receiving response-contingent shock as compared to the placed-shock condition.

The other two dependent variables also reflected the differences observed in the initial exit latency measure. The number of exits for placed shock as compared to response-contingent shock was significant ($F = 4.76$, $df = 1/20$, $p < .05$). The escape-nonescape variable had little effect ($F = .31$), and the interaction was also nonsignificant ($F = 2.32$). The amount of time in the shock compartment was significantly greater for Ss receiving placed shock as compared to response-contingent shock ($F = 10.40$, $df = 1/20$, $p < .01$). The escape-nonescape manipulation was nonsignificant, but its interaction with response-contingent/placed shock was significant ($F = 4.92$, $df = 1/20$, $p < .05$). This interaction was produced by the P-E group's staying in the shock compartment much longer than the P-NE group, while the RC-E group spent much less time in the shock compartment than the RC-NE group. This interaction should probably be viewed cautiously, since the other two dependent variables failed to show a significant interaction and it is clear from Table 1 that the three dependent variables are highly related.

Duration of shock for the response-contingent groups and the placed groups showed that the response-contingent Ss received significantly less shock than the placed Ss ($F = 5.55$, $df = 1/10$, $p < .05$). The mean duration of shock was 6.17 sec for the RC-E group (and their yoked group, RC-NE) but was 7.67 sec for the P-E group (and their yoked group, P-NE). The fact that the response-contingent groups showed better passive avoidance than the placed groups indicates that duration of shock in the range used in this experiment was ineffective compared to other manipulations. This finding is consistent with the data of Bolles, Grossen, & Hargrove (1969), who showed no difference due to shock duration in a range from 1 to 4 sec.

DISCUSSION

The results of this experiment are consistent with those reported by Calhoun & Murphy (1969). Delivering shock when the S leaves the safe area and enters the shock area is the most effective procedure for producing passive avoidance of the shock compartment. Escape from the shock compartment to the safe compartment seems to have little or no effect on subsequent passive avoidance behavior. This finding is also consistent with data regarding active avoidance (Calhoun & Murphy, 1969; Bolles et al, 1969).

It is probably the case that the present experiment is related to the work of Blanchard & Blanchard (1970a, b), which indicates that passive avoidance is governed by specific avoidance of an object, or an immobility reaction when no discriminable object is present. Thus if the shock compartment acts as a discriminable stimulus, the results might be understood in terms of the degree of discriminability of the safe and shock compartments as a function of response-contingent shock and placed shock. Specifically, response-contingent shock may result in the shock compartment's being more discriminable, since the S originally experiences no shock in the safe compartment but then experiences shock when it enters the shock compartment. The escape condition would seem to produce the same kind of differential experience, but the fact that the S enters the safe compartment during and following shock might interfere with the S's attending to any available cues which differentiate the safe and shock compartments. Thus, the apparent differences between response-contingent and placed shock may reflect a difference in the discriminability of the shock and safe compartments, and not necessarily a difference due to making shock contingent on a particular response.

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