Dual mechanisms in passive avoidance: II

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A yoked control procedure was used to investigate effects of number of shocks and shock object discriminability on behavioral changes accompanying passive avoidance. Differential numbers of shocks did not alter shock-situation activity. However, shock-situation entry latencies were increased only for Ss receiving shock each time they touched a poorly discriminable grid area. The results are interpreted as suggesting that number of shocks received is of less importance than shock object discriminability in determining the behaviors that constitute passive avoidance.

Blanchard & Blanchard (1970) have suggested that shock-object discriminability influences the behaviors that constitute shock avoidance. They reported that shock through a highly discriminable object leads to specific avoidance of that object, with little change in shock-situation activity or entry latencies. In contrast, Ss shocked through a poorly discriminable object were much less active and displayed reliably longer latencies to enter the situation in which they had been shocked.

Although these results consistently support an interpretation that discriminability of the shock object is a major determinant of subsequent avoidance behaviors, it should be noted that the groups receiving shock through the different shock objects required differential numbers of shocks to establish avoidance. Thus, it is possible that the number of shocks, rather than shock-object discriminability, produced the activity and entry latency differences of Blanchard & Blanchard (1970).

The present study therefore involved yoked control procedures that attempt to ensure equal numbers of shocks for groups shocked through objects of low, intermediate, or high discriminability.

SUBJECTS

The Ss were 32 95- to 99-day-old female albino rats and 16 193- to 197-day-old male albino rats from the colony maintained by the University of Hawaii Department of Psychology.

APPARATUS

The shock chamber used in Blanchard and Blanchard (1970) was the test situation in the present study. The only modification consisted of painting the Plexiglas connectors for the isolated grids with aluminum paint in an effort to reduce the discriminability of the isolated portion of the grids.

PROCEDURE

The 32 female rats were assigned randomly to four groups with eight Ss each, and the 16 male rats were assigned randomly to two groups of eight Ss each. Except for one group of female rats (female box-shock, FBS) who received shock through the high-discriminable box, all Ss were run in a low-discriminability (grid) situation. One group of female rats and one group of male rats received no shock (female grid control, FGC, and male grid control, MGC, respectively), while one group of each sex received shock each time they touched the isolated portion of the grids (female grid shocked, FGS, and male grid shocked, MGS, respectively). Each S in the remaining group of female Ss received, though the isolated grids, the same number of shocks as a yoked S in the box-shock condition. Thus, the number of shocks and the distribution of shocks among the Ss were identical for the FBS group and this female yoked grid-shock (FYGS) group.

The test and retest procedures were identical to those of Blanchard & Blanchard (1970) except that the retest session 30 min after the original test session was omitted.

RESULTS

Table 1 presents the mean and median numbers of shocks received by each of the shocked groups in the test session and the mean and median shock-object contacts for all groups during the retest sessions. As this table shows, the FGS group received reliably more shocks than the FBS group ($U = 13$, $p < .05$). The FGS group also received reliably more shocks than the MGS group, all but one of which received only a single shock ($U = 6.5$, $p < .005$).

During the single retest session, all shocked groups tended to touch the shock objects less frequently than did the nonshocked groups. Among the female Ss, the FGC group touched the shock object reliably more often than did the FYGS ($U = 0$, $p < .001$), FGS ($U = 5$, $p < .001$), or FBS ($U = 0$, $p < .001$) groups. Although the FBS and FGS groups and the FGS and FYGS groups did not differ reliably on this

measure, the FYGS Ss touched the shock object reliably more often in the retest session than did the FBS Ss. For the male rats, the MGS group made reliably fewer shock-object contacts than did the MGC group ($U = 7.5$, $p < .005$). Male-female comparisons failed to reveal reliable shock-object contact differences for either the shocked or nonshocked Ss.

Figure 1 presents the mean number of squares entered for each group, during the test and retest sessions. As it indicates, activity scores were very similar for the FGC and FBS Ss in both sessions. The MGC group tended to be somewhat less active than the FGC group. This difference was statistically reliable in the test session ($t = 2.28$, $df = 14$, $p < .025$) but did not approach statistical significance in the retest session.

Both the FYGS and the FGS groups were consistently less active than the FGC or FBS groups. In the test session, the FYGS group was reliably less active than the FGC ($t = 3.27$, $p < .005$) or the FBS ($t = 4.06$, $p < .001$) groups. The FGS-FGC and FGS-FBS differences were also statistically reliable ($t = 2.91$ and $t = 2.97$, respectively; $p < .01$). Activity differences for the FGS and FYGS groups did not approach an acceptable level of statistical significance. During the retest session, the same pattern of differences was obtained: the FYGS-FGC, and FYGS-FBS differences were again reliable ($t = 3.43$ and $t = 3.39$, respectively; $p < .005$), while the FGS Ss were again reliably less active than either the FGC or FBS Ss ($t = 3.28$ and $t = 3.22$, respectively; $p < .005$). FGS and FYGS activity differences again failed to approach an acceptable level of significance.

Finally, in both test and retest sessions, the MGS Ss were consistently and reliably less active than their controls ($t = 4.34$, $p < .0005$, and $t = 3.11$, $p < .005$, for test and retest sessions, respectively). The MGS group was also reliably less active than the FGS group, which was the least active of the female groups ($t = 2.24$, $p < .025$, and $t = 1.78$, $p < .05$, for test and retest sessions, respectively).

Table 1 also represents latencies to enter

Table 1
Shocks, Shock Object Contacts, and Entry Latencies for All Groups

Measures			Groups					
			FBS	FGS	FYGS	FGC	MGS	MGC
Number of Shocks	M		1.38	2.25	1.38		1.13	
	Mdn		1.00	2.00	1.00		1.00	
Shock Object Contacts	Test	M				11.88		19.75
		Mdn				10.50		16.50
	Retest	M	0	3.75	3.88	11.00	3.63	13.63
		Mdn	0	0	3.50	10.00	.50	14.00
Entry Latency	Retest	M	13.25	48.75	18.63	15.00	298.63	16.63
		Mdn	13.00	16.00	9.50	8.00	274.50	12.00

Fig. 1. Mean squares entered by each group, during the test and two retest sessions.

the shock chamber during the retest session for all groups. As the table shows, several Ss in each of the female grid shocked groups had very long entry latencies. However, only the FGS and FGC ($U = 15$, $p < .05$) and FGS and FYGS ($U = 10$, $p < .01$) groups differed reliably on this measure. For the male Ss, shock greatly increased entry latencies: four of the MGS Ss had entry latencies of over 480 sec. The MGS and MGC groups were reliably different on this measure ($U = 9$, $p < .01$), but entry latencies were not different for the MGS and FGS or for the MGC and FGC groups.

DISCUSSION

The close correspondence of activity scores for the FYGS and FGS Ss of the present study suggest that differential number of shocks is not a major determinant of the pattern of subsequent activity and avoidance. The reliably different activity scores of FYGS and FBS Ss indicate that variations in shock-object discriminability may produce activity differences, even when identical numbers of shocks are received. These two findings, therefore, strongly indicate that the activity differences of the shocked groups in Blanchard & Blanchard (1970) are primarily attributable to variations in the discriminability of the objects through which shock was given, and that the differences in the number of shocks received for these groups did not greatly influence subsequent activity in the shock chamber.

Although the present results clearly support the hypothesis that shock-object discriminability influences activity, the

present study is not unequivocal with respect to effects on shock-chamber entry latencies. The finding of reliably greater latencies for the FGS than for the FYGS Ss suggests that the number of shocks received may influence subsequent shock-chamber entry latencies. However, if this interpretation is correct, a difference of the FGC and FGYS groups would also be expected. This difference was not reliable, leaving the status of the effects of shock numbers on shock-chamber entry latencies somewhat in doubt.

Comparisons of performance of male and female rats in the present study indicate that older male rats tend to "passively avoid" low-discriminable shock objects after fewer shock experiences than do younger female rats. This superior passive avoidance was found in conjunction with reliably lower activity scores for the male Ss, suggesting that immobility may underlie avoidance of poorly discriminable shock objects. Although it is conceivable that the male Ss were able to discriminate the isolated grid area more quickly than were the female Ss, the finding that seven of the eight male Ss received only a single shock would appear to indicate that some mechanism other than discrimination was responsible for the very rapid acquisition of avoidance for the male rats. The entry latency scores for the MGS group also tend to support a hypothesis that situational fear, rather than fear of the specific shock object, was involved in the rapid avoidance acquisition of the male rats in the present study. Although the MGC Ss were reliably less active than FGC Ss in the test session, their activity difference in the retest session was not statistically reliable. It is, therefore, difficult to attribute the reliable MGS-FGS activity difference in the retest session to a lower general activity level for the male Ss.

Finally, although this pattern of results may indicate sex differences in passive avoidance of low-discriminable shock objects, the age and weight variations of the male and female Ss preclude such an unequivocal interpretation.

Thus, the present study, along with Blanchard & Blanchard (1970) provide additional evidence that at least two defensive reactions accompany the pairing of a neutral stimulus with pain. If pain and a highly discriminable neutral stimulus are paired, either active (Blanchard & Blanchard, 1969b) or passive (present study) discriminated avoidance behavior may be obtained. That is, the S tends to run away or stay away from the specific shock object. If the shock stimulus is poorly discriminable (Blanchard & Blanchard, 1969a; present study), strong immobility reactions characterized by crouching appear. Since both avoidance

and immobility reactions may be brought under stimulus control with one or two shocks, it appears likely that these behavioral reactions are preexperimentally acquired, and that they reflect either evolutionary adaptations or reactions learned in the early experience of the rat.

Both reaction patterns are elicited by stimuli associated with noxious events. This and rapidity of acquisition constitute the major points of similarity for the immobility and discriminated avoidance reactions. Since these reactions are not behaviorally similar, and since the conditioned stimuli that elicit them are quite different, it appears unreasonable to regard them both as indices of fear. Also, Blanchard & Blanchard (1969b) found reliable negative correlations between immobility in the shock situation and a discriminated avoidance response, again suggesting that these reactions do not measure the same mechanism. This finding also indicates that both immobility and discriminated avoidance may occur in the same situation, and that the resultant behavior may represent competition of the two defensive reactions. Finally, Blanchard, Blanchard, & Fial (1970) have reported that lesions of the hippocampus differentially affect immobility and discriminated avoidance reactions.

If discriminated avoidance provides a measure of fear of specific threatening stimuli, while immobility appears to characterize an emotional response to unlocalized threat, then these reactions may be primitive analogues of the responses characterized as "fear" and "anxiety" in humans. A number of authorities (cf. Arnold, 1960) have used the discriminability of the response-eliciting stimulus as a major criterion in a fear-anxiety distinction. Also, discriminated avoidance and immobility tend to suggest some of the response characteristics of human fear and anxiety reactions. Thus, it appears likely that there may be across-species generality as well as predictive value in a fear-anxiety distinction.

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