Table 2
Mean Speed of Responding in Extinction

Group	Mean Ft/Sec Per Trial Block 1	2	3	4	5	Mean Ft/Sec Across Blocks
CC-R	.1845	.0864	.0832	.0645	.0645	.0966
CP-R	.1651	.1000	.0684	.0617	.0546	.0900
PC-R	.5891	.4219	.1768	.0887	.0774	.2708
PP-R	.2107	.2018	.0842	.0697	.0600	.1253

response to another even in the same general experimental situation.

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The effect of septal lesions on acquisition of a classically conditioned fear response

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Septal lesions were placed in rats and the animals were then tested with two variations of the classical conditioning fear response. One variation involved the inclusion of an exploration procedure before the test session, which was designed to reduce response conflict between crouching, or freezing, and hurdle jumping. The other variation was a "no-exploration" condition. These two variations are assumed to be analogous to one-way avoidance conditioning and to two-way shuttlebox avoidance conditioning, respectively. Septal lesions reduced the level of performance under the "exploration" condition. The performance of septal-lesioned animals did not differ significantly from normals under the "no-exploration" condition.

The facilitative effects of septal sesions on acquisition during active avoidance conditioning were first reported by King (1958). Septal-lesioned animals were found to perform better than normals during acquisition, as measured by trials to a learning criterion.

These results were first replicated by Krieckhaus, Simmons, Thomas, and Kenyon (1964). They reported shorter avoidance response latencies, and a larger proportion of avoidance responses, for septal lesioned animals than for normals. The septal facilitative effect has been replicated many times (cf. Grossman, 1973; Fried, 1972).

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Kenyon and Krieckhaus (1965) reported that the septal facilitatory effect could not be demonstrated for one-way active avoidance conditioning, when the approach-avoidance conflict produced by two-way shuttle avoidance was removed by requiring the rats to jump in only one direction. Under these conditions, septal-lesioned rats performed *poorer* during acquisition than nomals.

Kenyon and Krieckhaus (1965) proposed that the septal lesions reduced fear and, therefore, the tendencies to crouch and freeze. The reduction in fear motivation presumably enhanced two-way CAR responding and reduced performance in the one-way avoidance situation.

The facilitative effect of septal lesions on two-way active avoidance conditioning may be an artifact of the conflict produced by the test situation, as suggested by the experiment of Kenyon and Krieckhaus (1965). An alternative conditioning procedure is the acquired drive, or conditioned fear, technique (Goldstein, 1960; McAllister & McAllister, 1971; Miller, 1948).

This conditioning procedure provides for the performance of an instrumental test response based upon fear acquired by means of classical conditioning. The amount of freezing and crouching may be manipulated by including an "exploration" session between the classical and instrumental test sessions.

With "exploration" of both compartments after classical conditioning and before the test session there is, presumably, minimal freezing and crouching. This test situation is comparable, in this respect, to one-way active avoidance conditioning. Without exploration, there is evidence of the freezing and crouching which is found in two-way avoidance conditioning.

Septal-lesioned animals conditioned with the exploration procedure should, therefore, show the performance decrement demonstrated by Kenyon and Krieckhaus (1965) for one-way avoidance conditioning. Septal-lesioned animals conditioned without exploration between classical and instrumental sessions should show the septal facilitative effect on performance described by King (1958) for two-way active avoidance conditioning.

METHOD

Subjects

The subjects were 12 naive male albino rats supplied by the Holtzman Company, Madison, Wisconsin. They were 90 days old on arrival and 135-165 days old at the start of the experiment. Their weights ranged from 397-487 g. They were maintained, ad lib, on Purina Rat Chow throughout the course of the experiment.

There were three subjects in the septal "exploration" group, three subjects in the normal "exploration" group, three subjects in the septal "no-exploration" group, and three subjects in the normal "no-exploration" group.

Apparatus

The apparatus was a black conditioning box divided by a guillotine-type door and a hurdle into two compartments. The compound CS was a buzzer and light. The UCS was a 60-cycle ac current conducted to the grid through a 250,000 ohm series resistor. UCS intensity was 250 V ac or .83 mA. Further details of the apparatus have been described earlier (Goldstein, 1960).

Procedure

An experimental session was divided into a "classical" conditioning and an "instrumental" test session. There were four experimental phases for the "exploration" groups.

Phase I. Exploration. Subject was placed into the grid compartment, with the guillotine door raised, for a period of 10 min. During this time, CS and UCS were off, and subject was permitted free exploration of both compartments of the conditioning box. At the end of the 10-min exploration period, the guillotine door was lowered and subject was placed into the grid compartment for 1 h, 3 min.

Phase II. Classical Conditioning. Classical conditioning trials were begun immediately after exploration and adaptation. A classical conditioning trial consisted of one successive presentation of CS and UCS in the grid compartment. The interval between CS and UCS onset was 4 sec, UCS duration was 1 sec, and CS and UCS were terminated simultaneously. Successive CS-UCS presentations were separated by 3-min intervals. Subjects were given nine CS-UCS presentations.

Subjects were removed from the grid-compartment 3 min after the start of the last conditioning trial and were taken to the home cage in the animal room, where they remained for 5 min with food and water available.

Phase III. Exploration. A second 10-min exploration session in the conditioning box was given immediately afterwards. At the end of this session, a final 10-min period in the home cage was given.

Phase IV. Instrumental test trials. "Instrumental" hurdle-jump conditioning sessions were started immediately after the last period in the home cage. The purpose of the hurdle-jump trials was to measure the strength of classical "fear" conditioning by presenting CS without UCS. Subjects were required to learn to jump across a hurdle from the grid-floor into the wooden-floor compartment when CS was turned on and the door separating the two compartments was opened. CS was turned off as soon as the response had been made. The response measure used was hurdle-jump latency.

Each subject received 20 hurdle-jump acquisition trials during a 45-min test period that began 28 min after the last classical conditioning trial. These trials were separated by 2-min intervals.

For the "no-exploration" groups, the first "exploration" period was replaced by an "adaptation" session, during which the subject remained in the grid compartment, with CS and UCS turned off. The second "exploration" session was replaced by a period in the home cage. These subjects, therefore, had never been over the hurdle before the instrumental test session.

Surgical and histological procedures. The lesions were produced electrolytically with the aid of a Baltimore Rat Stereotaxic Instrument. The stereotaxic coordinates used were 1.0 mm anterior to the bregma, 3.0 mm lateral to the midline, 5.5 mm below the dura, angle of 25 deg. The lesioning current was 2.0 mA lasting for 20 sec. Subjects were run after a 5-day postoperative recovery period. At the conclusion of the experiment, the animals were sacrificed and frozen coronal sections of the brain were made and examined microscopically. The location of the lesions was verified by comparing the sections with plates from the Konig & Klippel (1963) atlas.

RESULTS

The hurdle-jump latencies were transformed to reciprocals and summed over blocks of five trials. The

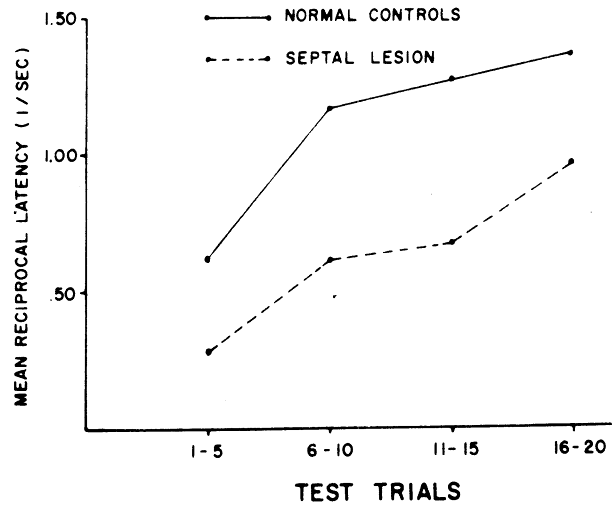

Figure 1. Performance functions for septal lesioned and normal rats under the "exploration" condition.

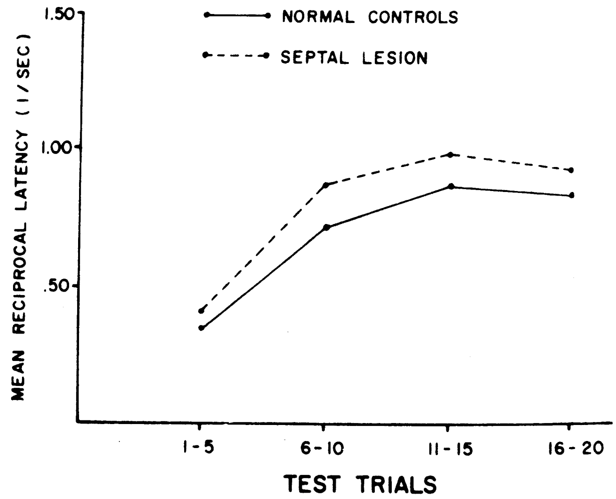

Figure 2. Performance functions for septal lesioned and normal rats under the "no-exploration" condition.

mean of a block of five trials was the score used in the statistical analysis.

Comparison of the performance measures for the septal lesioned and normal animals, for the "exploration" condition, by means of the trend analysis of variance (Edwards, 1960) yielded an F of 21.30, which was significant beyond the .01 level of confidence. The performance functions for these two groups are shown in Figure 1. The septal-lesioned animals learned the hurdle-jump task but performed *poorer* than their normal controls on this this test.

For the "no-exploration" condition, the comparison between the performance measures for the septal-lesioned and normal animals yielded an F which was not significant [$F(1,4) = .20$]. There was, therefore, no significant difference between the performance functions for the septal-lesioned and normal subjects under the "no-exploration" condition. The performance functions for these two groups are shown in Figure 2.

There were no differences in preconditioning spontaneous activity between the septal-lesioned and normal subjects [$t(4) = .70$]. The conditioning session had no effect on the activity of the septal-lesioned subjects, as measured by spontaneous hurdle crossings.

A nine-point behavorial rating scale indicated that the general level of emotionality on the first postoperative day was higher for the septal-lesioned animals than for the normals.

DISCUSSION

The results of this experiment indicated that septal lesions reduced performance of the classically conditioned fear response below the normal level when the "exploration" condition was used and had no effect on performance when the "no-exploration" condition was used. The auxilliary measures of spontaneous activity indicated that the operation had no effect on the general activity of the animals.

The finding of poorer performance than normal for the septal lesioned animals, under the condition of "exploration," confirms the hypothesis that septal lesions reduce fear under the conditions of reduced response conflict of the classically conditioned fear situation which are comparable to one-way avoidance conditioning. The expected facilitative effect of septal lesions on classical fear conditioning was not obtained under the "no-exploration" condition. It is quite possible, however, that with a longer delay between the operation and the behavioral test than the 5 days used in the present experiment some facilitation of performance might be found.

The findings of no difference in the activity measures for the septal and normal animals suggests that differential tendencies to crouch and freeze, in the two groups, were not important determiners of performance under the conditions of the present experiment.

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