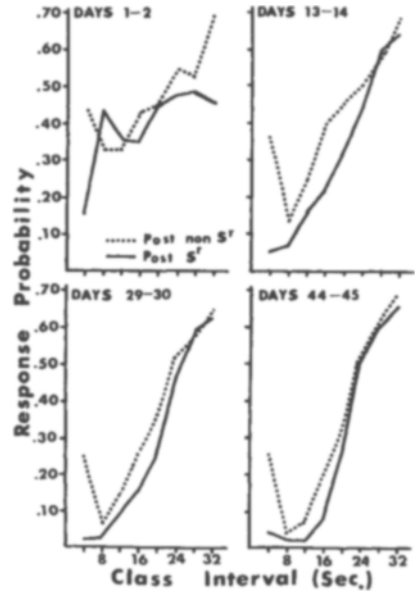

Fig. 2. Development of post S^R and post non-S^R IRT/Opportunity distributions across 45 training sessions. The data are plotted at the upper limit of the class interval.

were used. Following the 45 training sessions all Ss were allowed 2 days of ad lib feeding, then anesthetized with Nembutal and given bilateral lesions of the septal nuclei. The lesions were created by passing 1.5-mA anodal dc for 20 sec through the uninsulated tip of a stereotaxically guided stainless-steel electrode. Coordinates were 1.5 mm A, .5 mm L, and 6.0 mm D, with respect to the bregma, and with the head at a 5-deg angle to a horizontal plane. After surgery 30,000 units of Bicillin were administered.

Postoperatively Ss were allowed 3 days of ad lib feeding, followed by 3 days of readjustment to the deprivation schedule. After 12 daily test sessions on the DRL 20-sec schedule they were anesthetized with an overdose of Nembutal and perfused with saline and formalin. The brains were removed, fixed in acid formalin, dehydrated in pyridine, embedded in celloidin, and sectioned at 15 $m\mu$. Sections throughout the lesion were stained with cresyl violet and Luxol fast blue MBS.

Results and Discussion

The lesions were similar to many previously described in the literature. Damage started anterior to the genu of the corpus callosum and extended posteriorly to the columns of the fornix. In all Ss the lateral and medial septal nuclei were destroyed, but some supracommissural septal tissue remained intact.

The pre- and postoperative IRT/Opportunity results are presented in Fig. 3. They are based on all Ss and averages of 6 and 12 sessions, respectively. Postoperatively all Ss were deficient in inhibiting short- and medium-latency responses, with the response probability increasing with the time since a previous response. The effects were more marked for the post-non-S^R component, suggesting that the cue value of S^R partially counters the lesion-induced effects.

Comparison of response probabilities using the Walsh test indicated that the response probabilities for the 4-8 sec, 8-12 sec, 12-16 sec, and 16-20 sec intervals were significantly greater in their magnitude of change for the post-non-S^R distributions ($p < .062$). Similar results were found for percentage of reinforced responses. In all Ss the decreases were greater for the post-non-S^R component. Of interest is the slight decrease in the number of 0-4 sec latency post-non-S^R responses following the lesions. If such responding reflects frustrative behavior, their decrease in frequency following lesions would suggest that affective changes are not responsible for the observed deficit.

The results suggest that a significant portion of the septal deficit in DRL responding results from a disruption of ritualized mediating behavior between responses and not disinhibition of lever pressing entirely. Such a deficit might include the omission of particular behavioral sequences or a tendency to terminate such sequences prematurely.

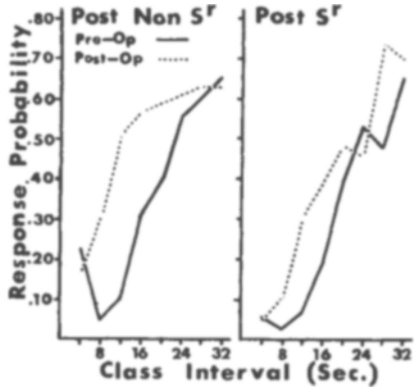

Fig. 3. Postoperative changes in post S^R and post non-S^R IRT/Opportunity curves following septal lesions. The data are plotted at the upper limit of the class interval.

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NOTES

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Stimulus compounding with an instrumental avoidance response

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A light and buzzer each separately maintained a latency of response which avoided shock in a shuttle box. When the light and buzzer were compounded, the latency was significantly shorter than the latency to either single stimulus. This result reliably occurred only with Ss that had a high percentage of avoidance responses and fairly short latencies to the single stimuli. The results were interpreted in terms of summation of response tendencies.

When two conditioned stimuli, each capable of maintaining a response, are

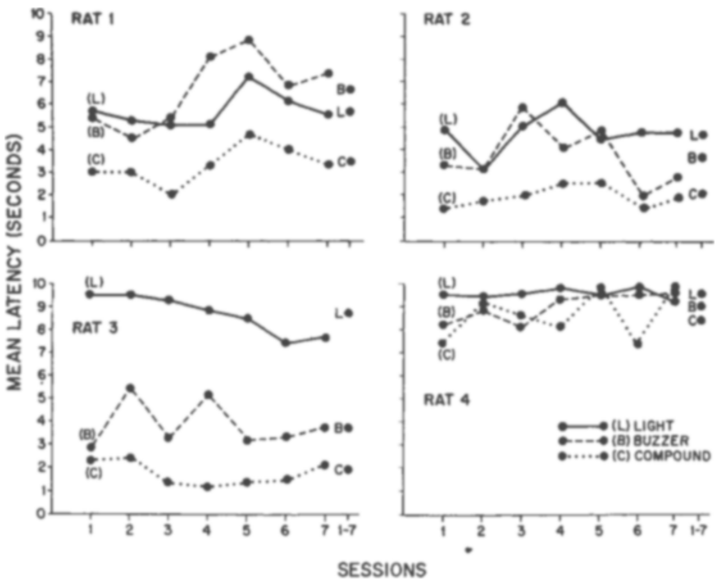

Fig. 1. Mean latencies of avoidance to single stimuli and their compound.

combined, their compound produces a greater magnitude or rate of response than either stimulus alone. This summation of response tendencies has been demonstrated in classical (Hull, 1940; Grings & O'Donnell, 1956) and free-operant (Wolf, 1963; Weiss, 1964) conditioning.

The present experiment is an extension of compounding-summation to an instrumental avoidance response. If two stimuli, each maintaining a latency of avoidance responding, are combined, summation of response tendencies would predict that the latency produced by the compound be less than the latency maintained by either single stimulus.

PROCEDURE

The Ss were five male albino rats, 100 days old and maintained on ad lib food and water. The apparatus was a 22 x 18 x 12 in. flat black plywood shuttlebox with a grid floor of 1/8-in. steel rods spaced ½ in. apart. The stimuli, a 25-W lightbulb and a Potter and Brumfield BU 120 V buzzer, were positioned at the midline of the box, the light 9 in. from the floor on the inside rear wall, and the buzzer on a platform outside the box 6 in. away from the rear wall. The shock source was a Grason-Stadler shock generator. Latencies were measured with a Stoelting electric timer, accurate to .01 sec.

Subjects were run in a two-way avoidance situation. Either a light or buzzer was presented on each trial. If S crossed the midline to the other side before 10 sec, it avoided shock, and the light or buzzer was terminated. If S did not cross within 10 sec, shock was presented until S moved to the other side, whereupon both shock and stimulus terminated simultaneously. The same procedure was repeated when S was on the other side. Latency, the time from stimulus onset until S crossed the midline, was measured. If S did not cross within 10 sec, the latency was recorded as 10 sec. Shock was applied to the side S had just left during the 60-sec intertrial interval to prevent premature crossings. Ss were given 20 trials to each stimulus each day. The order of light and buzzer presentation was randomly determined. Shock intensity for each S was adjusted to produce a mean latency of avoidance responding to each stimulus as near to a range of 4-7 sec as possible. Intensity varied from .16-.60 mA.

After 8 days Ss 1-3 had attained, in each session, both the desired latency and a high percentage of avoidance responses to each stimulus. The per cent avoidance to the light and buzzer, respectively, was 90-100% for Ss 1 and 2 and 60 and 90% for S 3. For S 4 the percentages were 25-35%, with latency from 8-9 sec. S 5 never learned to avoid, only to escape.

For testing, the 40 trials were divided into five blocks of eight trials. Light and buzzer were compounded once each block. The compound trial was randomly determined. Seven sessions of testing, one session each day, were conducted. S 5 was tested for only three sessions. Thus, Ss 1-4 each had five compound tests in each session, for a total of 35 tests over the seven test sessions.

RESULTS AND DISCUSSION

The results of the seven tests for Ss 1-4 are presented in Fig. 1. The mean latency of the five compound tests each session is plotted against the means of the light and buzzer. At the right of each graph are the mean latencies from pooling the data from the seven test sessions. The mean latencies to single stimuli and compound for S 5 were all 10 sec. A treatment by Ss analysis of variance of each S's data revealed a significant difference due to stimulus condition ($p < .01$) for Ss 1, 2, and 3. For S 4, $p = .07$, and for S 5, $p > .25$. A Newman-Keuls post hoc comparison of the treatment means for Ss 1-3 revealed that the latency produced by the compound was significantly shorter than the latency to either light or buzzer alone. For Ss 1 and 2, $p < .01$; for S 3, $p < .01$ for the compound vs light comparison and $p < .05$ for the compound vs buzzer comparison.

The data support a summation-of-response-tendencies interpretation. When two stimuli, each maintaining a certain latency of avoidance responding, were combined, their compound produced a significantly shorter latency. It also appears that the latency to the compound is a function of the latency and per cent avoidance maintained by the single stimuli. For Ss 1-3, latencies were low and per cent avoidance was high, and the latency to the compound was reliably and significantly shorter. However, for S 4, latency to both single stimuli was high and per cent avoidance was low, and the latency to the compound was neither reliably nor significantly shorter. S 5, which never learned to avoid at all to either stimulus, also never avoided to the compound.

These results are consistent with results reported by Miller (1969). A light and tone were established as preaversive stimuli which suppressed the rate of a lever-pressing response. The compound of these single stimuli suppressed responding even further. Furthermore, a compound composed of two highly suppressive stimuli suppressed responding more than did a compound of two less suppressive stimuli.

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NOTE

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