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# 6-OHDA Induced Effects Upon the Acquisition and Performance of Specific Locomotor Tasks in Rats

MARK WATSON[1] AND JAMES G. McELLIGOTT[2]

*Department of Pharmacology, Temple University School of Medicine, Philadelphia, PA 19140*

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WATSON, M. AND J. G. McELLIGOTT. *6-OHDA induced effects upon the acquisition and performance of specific locomotor tasks in rats*. PHARMACOL BIOCHEM BEHAV **18**(6) 927–934, 1983.—The effect of norepinephrine (NE) depletion on acquisition and performance of locomotor tasks requiring precise paw placement was tested. Running times (RT, 25 trials/day, 4 consecutive days) of water-deprived rats trained to transverse horizontal rods in an equally spaced regular rod arrangement (REG) were obtained before and after (REG/REG) intracisternal 6-hydroxydopamine (6-OHDA, 3× 25 μg free base) infusion. No significant differences from ascorbate (0.1%) vehicle controls were seen. Additional rats were tested using the same protocol except a more difficult, irregularly spaced rod arrangment (IRR) was used. These IRR/IRR rats also revealed no significant differences. However, testing on the REG task before, and the new IRR task after infusion produced impaired performance on days 3 and 4 when 6-OHDA and vehicle treated rats were compared. These REG/IRR rats also showed a significant difference in the slope of the line reflecting the decrease in RT over the 4 day post-infusion period. Since no differences in intertrial intervals or extinction behavior were seen, the effect was not attributed to differences in arousal or motivational state. This effect could not be attributed to a simple reduction in non-specific activity, since significant differences in spontaneous locomotor activity or open field behavior were not seen. Assays verified the severe reduction of cerebellar NE to 14.5% of vehicle controls, and the smaller reduction in limbic forebrain NE and dopamine (53.8% and 75.2% of controls respectively). These findings suggest that NE deafferentation of the cerebellum causes impaired acquisition of locomotor behavior rather than an impairment of post-acquisitional performance.

6-Hydroxydopamine Catecholamines Norepinephrine Learning Memory Running time Extinction Cerebellum Locomotion Intertrial interval

NOREPINEPHRINE (NE) has long been considered to be involved in learning processes [9, 10, 11, 28, 29]. The small pontine nucleus locus coeruleus (LC) has become a subject of intense study since it was identified as a major source of central NE [53]. Kety [28,29] hypothesized that NE may facilitate consolidation of learning by stimulating protein synthesis or by some other trophic processes occurring at recently activated synapses. It has been further suggested that NE released in the cerebral cortex from terminals of the dorsal noradrenergic bundle (DNB) serves to change the synaptic structure of cortical circuits which may encode the learning experience [9, 10, 11]. Kasamatsu *et al.* [27] have recently demonstrated that NE is involved in the maintenance of visual cortical plasticity, providing support for this hypothesis.

In a related hypothesis it has been suggested [20,42] that noradrenergic innervation of the cerebellum [41] is necessary for motor responses to be learned. Thus, the LC may play a crucial role in consolidating motor signals stored in the cerebellum. Indeed, stimulation of the LC has been shown to produce an increased release of NE and a subsequent reduction in spontaneous activity at the only output cell of the cerebellar cortex, the Purkinje cell [23, 24, 25, 47]. NE also enhances Purkinje cell response to afferent input [18,39]. Thus, NE release might provide enhanced retention and a subsequent increased ability to acquire motor skills [20].

An integral role has thus been proposed for NE in both associative and motor learning. NE's hypothesized role in motor learning behavior was evaluated in this study. Acquisitional and post-acquisitional performance of specific locomotor skills requiring precise paw placement were tested before and after destruction of central NE terminals [5] by intracisternal infusion of 6-hydroxydopamine (6-OHDA).

## METHOD

### *Subjects*

Experimentally naive male Sprague-Dawley albino rats (Zivic-Miller Laboratories, Pittsburgh, PA) aged approximately six weeks and initially weighing about 200 g were

[1]Present address: Departments of Pharmacology and Internal Medicine, University of Arizona College of Medicine, Tucson, AZ 05724.
[2]Requests for reprints should be addressed to Dr. James G. McElligott, Department of Pharmacology, Temple University School of Medicine, 3420 North Broad Street, Philadelphia, PA 19140.

used for these experiments. They were individually housed in a temperature controlled room on a 12 hr light-dark cycle. Free access to both dry pellet food and water was allowed except as otherwise noted.

*Intracisternal 6-OHDA Injections*

In order to provide maximum preferential depletion of NE with minimal interference of dopaminergic systems, 6-OHDA (Sigma Chemicals) was administered in three small doses equally distributed over a seven day period [7,24]. Intracisternal infusions using a Hamilton syringe were delivered freehand to rats placed under ether anesthesia and positioned in a stereotaxic apparatus (Kopf Instruments). After the initial half of the total volume was slowly injected over a 2 min period, the remaining half was injected following slight withdrawal of the needle to allow increased difussion of the 6-OHDA. The needle was also left in place for an additional 1–2 minutes to help diminish leakage resulting from backflow due to the transient rise in intracranial pressure.

Solutions of 6-OHDA were prepared fresh daily within a cold nitrogen atmosphere to prevent auto-oxidation. Each of the three 25 $\mu$g doses (expressed as free base of 6-OHDA hydrochloride) was dissolved in 25 $\mu$l of 0.9% sterile saline with 0.1 mg/ml ascorbic acid added as an antioxidant. Control animals received ascorbate-saline vehicle infusions of equal volume. Before the resumption of testing, a post-infusion recovery period of 13 days was allowed for 6-OHDA uptake and subsequent degeneration to occur.

*Apparatus*

The runway apparatus for locomotor behavioral testing was constructed of plywood and painted black (Fig. 1). It consisted of a straight runway (length = 127 cm, width = 6 cm, and wall height = 25 cm) with a readily changeable arrangement of 38 horizontal stainless steel rods which made up the floor. These rods (diameter = 4 mm) were alternately placed on opposite walls of the runway at regular intervals. They extended 2.25 cm from the wall with an inter-rod distance of 2.5 cm. Figures 1A and 1C illustrate this equally spaced regular rod arrangement (REG). An irregular rod arrangement (IRR), created by selectively removing 6 scattered rods from the runway (Fig. 1D), was used in some experiments. Two photocell beams (interbeam distance = 20 cm) were located 3 cm above the floor in the middle portion of the runway to measure running times. A 10 cm by 15 cm aluminum platform was situated at either end of the runway with a spout (length = 2 cm) located at a height of 4 cm. Water reinforcement (0.1 cc) was automatically delivered via a solenoid which discharged with a loud click when a rat made simultaneous contact with the platform floor and the spout at the initiation of drinking.

*Training Procedures*

Rats were water deprived for 36–48 hours prior to the initiation of training. Throughout runway training and testing, free access to water was allowed for only 3 minutes each day, though food was available ad lib. With the aid of a flat surface placed over the rods (Fig. 1B), rats were trained for approximately 1 week (total training time approximately 7 hours/rat) until they were able to run successively back and forth in the runway. A water reward was given at either end after each successful crossing and subsequent contact with the spout which was necessary to constitute a completed trial. As training progressed, sections of the wooden board were removed to gradually expose the floor of equally spaced horizontal rods, until each rat traversed the entire length of this regular rod arrangement (REG). Data collection began immediately following the first two trials each of which were successfully completed in less than one minute.

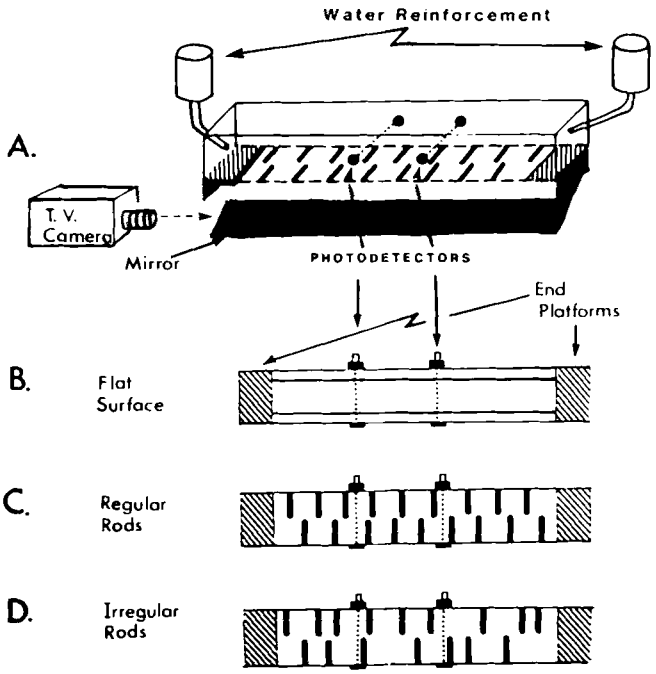


FIG. 1. (A) A diagrammatic illustration of the runway showing the T.V. camera and mirror arranged to record paw placement on the rods which make up the floor. Overhead views of (B) the flat board used in initial training, (C) the equally spaced rods of the REG task (D) the unequally spaced rods of the IRR task. These are pictorial and not exact illustrations of the runway. The exact dimensions are stated in the Method section.

*Experimental Design*

*Post-acquisitional performance.* In order to determine the effects of central NE depletion on the performance of a previously learned locomotor task, rats were run on the equally spaced REG task for 4 successive days. They were then infused (3×) with either 6-OHDA or vehicle. Following a 13 day post-lesion period to allow for maximal NE depletion, these rats were again tested on the same REG task for an additional 4 days.

Further testing of post-acquisitional performance was carried out in a second group of rats, on the similar but more difficult IRR task. The same protocol described above was followed except rats were run on the unequally spaced IRR task. After 4 days of initial IRR testing, they were infused with 6-OHDA or vehicle and then retested on the same IRR task for 4 additional days.

*Acquistional Performance.* In order to determine the effect of 6-OHDA-induced NE depletion on the acquisition of a locomotor task to which there was no previous exposure, additional rats were run on the REG task prior to infusion.

After 6-OHDA or vehicle treatment, they were run on the new and more difficult IRR task.

### *Indicies of Runway Performance*

*Running time.* The total time elapsed while each rat crossed between the two photodetectors was termed the running time (RT) for each trial. Daily performance was assessed by averaging the RT on a digital computer (PDP 11/40) for approximately 25 successive trials.

*Intertrial intervals.* During runway testing each animal exhibited a characteristic latency, or total time spent on the goal platforms at either end of the runway. This intertrial interval began with the delivery of water reinforcement, included time for reversing direction, and ended when the rat crossed a photodetector while running to the opposite platform. These data were collected only for REG/IRR rats on the REG before, and on the IRR after intracisternal 6-OHDA or vehicle infusion. This intertrial interval time was taken as an indication of the arousal and motivational level of each individual animal.

*Extinction behavior.* Following testing with water reinforcement, REG/IRR rats were run on the IRR task for an additional 4 days without the water reward in order to observe extinction behavior. For the first two days the water was removed, while a secondary reinforcer (solenoid click) was still provided. On the second two days, neither was provided. The mean number of trials to extinction was recorded, as were the mean running times within these trials. The criterion for extinction was met when an animal remained in the goal box for 2 min.

### *Other Indices of Behavior*

*Spontaneous locomotor activity.* Total nocturnal spontaneous locomotor activity was measured in figure 8-shaped photocell activity monitors similar in design to those previously described by Norton *et al.* [40]. Interruption of photodetector beams incremented a counter that cumulated counts for consecutive 1 hour intervals. Data were collected over a twelve hour test period beginning at 1900 hr and ending at 0700 hr. Testing was carried out following the post-infusion recovery period of 13 days, and determinations were made both for individual rats as well as for group housed (where n=4) rats. Since rats were concurrently being tested on the runway tasks (REG/IRR), water was not freely provided, though food was scattered throughout the activity cages.

*Exploratory open field.* Both during pre-infusion (REG) and post-infusion (IRR) runway testing, these same rats (REG/IRR) were observed individually in an open field consisting of four 35 cm × 35 cm square areas. This was done each day following runway testing, prior to insertion in the spontaneous locomotor activity monitors for the evening. Scoring was kept for the number of squares crossed, rearings, and grooming episodes over a 3 minute test period. Behavior was observed for 4 successive days in both pre- and post-infusion condition.

### *Biochemical Assay*

At the conclusion of behavioral testing, neurochemical analysis was carried out in (REG/IRR) rats in order to verify the extent of catecholamine depletion. Rats were sacrificed by decapitation and the brains were rapidly excised from the skull and placed on a glass plate over ice to minimize oxidation during dissection. The cerebellum was quickly removed by blunt dissection of the cerebellar peduncles, and a cut was made at the optic chiasm to provide a sample of the limbic forebrain. The excised tissue was wrapped in aluminum foil and immediately quick-frozen by immersion in liquid nitrogen. It was briefly kept over solid carbon dioxide until subsequent storage at −90°C.

Quantitative determinations for NE and dopamine (DA) were made using high performance liquid chromatography with electrochemical detection (Bioanalytical Systems LC 303, West Lafayette, IN) using a simplified method which eliminates a preliminary purification step [2]. Calculations for catecholamines were based upon peak height ratios of NE and DA to the internal standard, dihydroxybenzylamine [16]. Concentrations were corrected for fresh brain weight and reported as ng/g wet weight.

### *Data Analyses*

Since there was a wide range of individual rat's running times, all runway data were normalized. The mean running time for each rat's initial performance on a particular rod arrangement (REG or IRR) was assigned a value of 100%. Semi-log plots of performance over these 4 day periods were used to test for the effects of central NE depletion.

Analysis of variance techniques and two-tailed $t$-test were used to analyze the data, unless otherwise specified. A slope comparison test and standard linear regression analysis were also employed [52]. Differences were considered statistically significant only for values of $p<0.05$.

## RESULTS

### *Post-acquisitional Performance*

A semi-log plot of pre- and post-infusion RT for rats on the REG task is shown in Fig. 2A. The mean RT on the first day of pre-infusion testing was 1.07±0.70 sec (speed =18.7 cm/sec). Over a 4 day period, rats ran 40% faster.

Both 6-OHDA and vehicle treated rats showed a slight increase (10%) in RT immediately following the post-infusion recovery period. Subsequent post-infusion performance on this same REG task showed no significant differences.

The data obtained for rats tested on the more difficult IRR task before and after infusion is shown in Fig. 2B. Pre-infusion mean RT on the first day was 1.38±0.16 sec. No significant differences were observed when 6-OHDA and vehicle injected rats were compared over 4 days of post-infusion testing on the same IRR task.

The slopes of data plots which describe the rate of acquisition on the more difficult IRR task (m=−6.60), and the comparatively easier REG task (m=−7.15) are not significantly different. Both treated and control rats (IRR/IRR) both demonstrated a slight increase in RT immediately following recovery from infusion, similar to that seen in REG/REG rats. These increases in RT are probably due to the period of absence from the runway incurred while time was allowed for infusion (7 days) and recovery (13 days). Moreover, since the 6-OHDA rats failed to differ from the vehicle treated in both REG/REG and IRR/IRR tasks, it may be concluded that intracisternal 6-OHDA administration fails to alter the ability to perform a previously learned runway task, regardless of its difficulty.

### *Acquisitional Performance*

In another experiment, rats initially tested on the REG

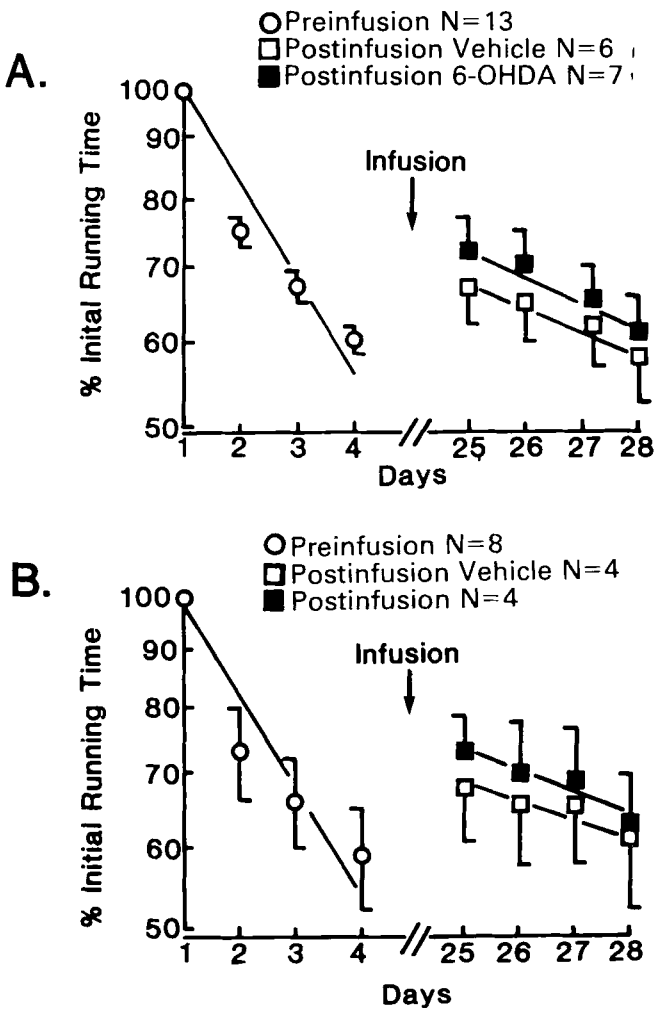


FIG. 2. No difference in post-acquisitional performance was seen between the groups of 6-OHDA and vehicle treated rats on tasks of (A) lesser (REG/REG) or (B) greater (IRR/IRR) difficulty. These semi-log plots show the normalized mean RT (±standard error) of rats tested upon the same pattern before (days 1–4) and after (days 25–28) infusion.

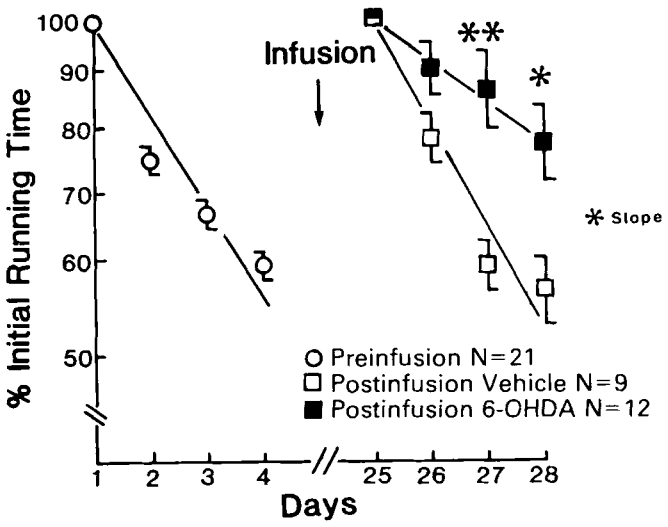


FIG. 3. A semi-log plot of the RT (±standard error) for rats tested on the REG task prior to infusion and switched to the IRR task after infusion. Each RT was normalized with respect to the first days' performance on the particular arrangement (day 1 for REG and day 25 for IRR). 6-OHDA treated rats were found to be significantly impaired when their RT was compared with the RT of vehicle treated counterparts. Both the third (day 27) and fourth (day 28) post-infusion test days revealed statistically significant differences, as did the slope of the line through the 4 day data points for the IRR task. *$p<0.05$; **$p<0.02$.

task prior to infusion, were switched for 4 days of additional testing on the new and more difficult IRR task to which they had no previous exposure (Fig. 3). Post-infusion mean RT on the first day for the 6-OHDA treated rats (1.33±0.16 sec) was not significantly different ($t$-test) from the vehicle treated rats (1.49±0.19 sec). If the mean RT for each group of these rats (REG/IRR) is compared to the pre-infusion IRR mean first day RT of IRR/IRR rats, no significant differences are found. This suggests that neither earlier training on the REG task, or 6-OHDA administration had any measureable effect upon the first day of post-infusion IRR testing.

Clearly however, the most significant finding was that the semi-log plot of this REG/IRR data showed a significant difference ($t$-test) in post-infusion performance on day 3 ($p<0.02$) and day 4 ($p<0.05$). By day 4, the vehicle group ran 43% faster, while 6-OHDA treated rats ran only 23% faster. A significant difference (slope comparison test, $p<0.05$) was also seen in the slopes of the lines for 6-OHDA (m=−3.60 and vehicle treated (m=−8.46) rats.

*Intertrial Intervals*

The mean pre-infusion day one intertrial interval times for these REG/IRR rats was 23.4±2.0 sec. Though this time decreased with repeated daily exposure to the task, (14.0 sec for day 4) there was a subsequent increase in these times for both the 6-OHDA (19.1±2.0 sec) and vehicle treated groups (18.6±3.1 sec) as a result of exposure to the new IRR task on the first day following recovery from infusion (Fig. 4). This increase may be attributed to absence from the runway during post-infusion recovery or to the introduction of the new IRR task. No significant differences were found between the intertrial intervals of the 6-OHDA treated group and the vehicle group ($t$-test and slope comparison test).

*Extinction Behavior*

When the water reward was withheld, no significant differences in extinction behavior were found between the 6-OHDA and vehicle treated REG/IRR rats. Comparisons were made for the number of trials to extinction (Fig. 5A) and the mean RT (Fig. 5B) on the IRR task. This was true whether the secondary reinforcer (solenoid click) was present (days 1 and 2) or absent (days 3 and 4).

*Spontaneous Locomotor Activity*

Nocturnal spontaneous locomotor activity, for both individually housed (data not shown) and group (where n=4) housed rats showed no significant differences when 6-OHDA

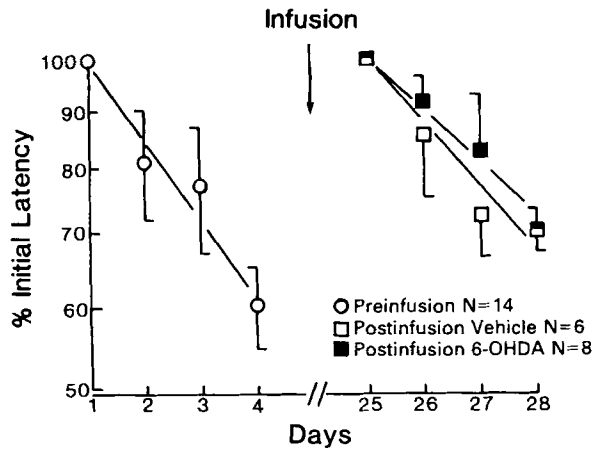


FIG. 4. No differences were found among normalized intertrial intervals (±standard error) of these REG/IRR rats.

and vehicle treated REG/IRR rats were compared (analysis of variance). This suggests that differences in performance were not simply the result of a generalized suppression of non-specific or non-goal-directed locomotor activity.

*Exploratory Open Field*

Observations of REG/IRR rats is an exploratory open field also failed to show any behavioral abnormalities. Treated rats, like their vehicle counterparts, tended to circle the edge of the field. Furthermore, a comparison of 6-OHDA and vehicle treated rats showed no significant differences in either the number of squares crossed, rearings, or grooming behavior (Fig. 6).

*Biochemistry*

Neurochemical data (Table 1) was gathered from one group of the REG/IRR to verify the expected depletion [6, 7, 48, 54] of brain catecholamines resulting from intracisternal 6-OHDA infusion. The principal effect of the 6-OHDA infusion was a significant depletion of central NE, with a concomitant more modest reduction of central DA stores. There was a severe reduction in cerebellar NE, where levels in 6-OHDA treated animals were 14.5% of vehicle control values. In the limbic forebrain, 6-OHDA treated rats were found to have NE levels of 53.8%, and DA levels of 75.2% of vehicle treated rats.

## DISCUSSION

Intracisternal 6-OHDA administration, which produced a severe reduction in cerebellar NE, also produced a significant impairment in the acquisition of a new IRR task to which the rats (REG/IRR) had not been previously exposed. Since 6-OHDA treated rats exposed to the IRR task prior to infusion ran in a manner that was indistinguishable from vehicle treated rats (IRR/IRR), this deficit is not simply due to task difficulty or a decrement in ability to perform the locomotor task. The failure to demonstrate post-infusion impairment in these IRR/IRR or REG/REG rats provides strong evidence that post-acquisitional performance was not affected by 6-OHDA treatment. Rats experienced difficulty

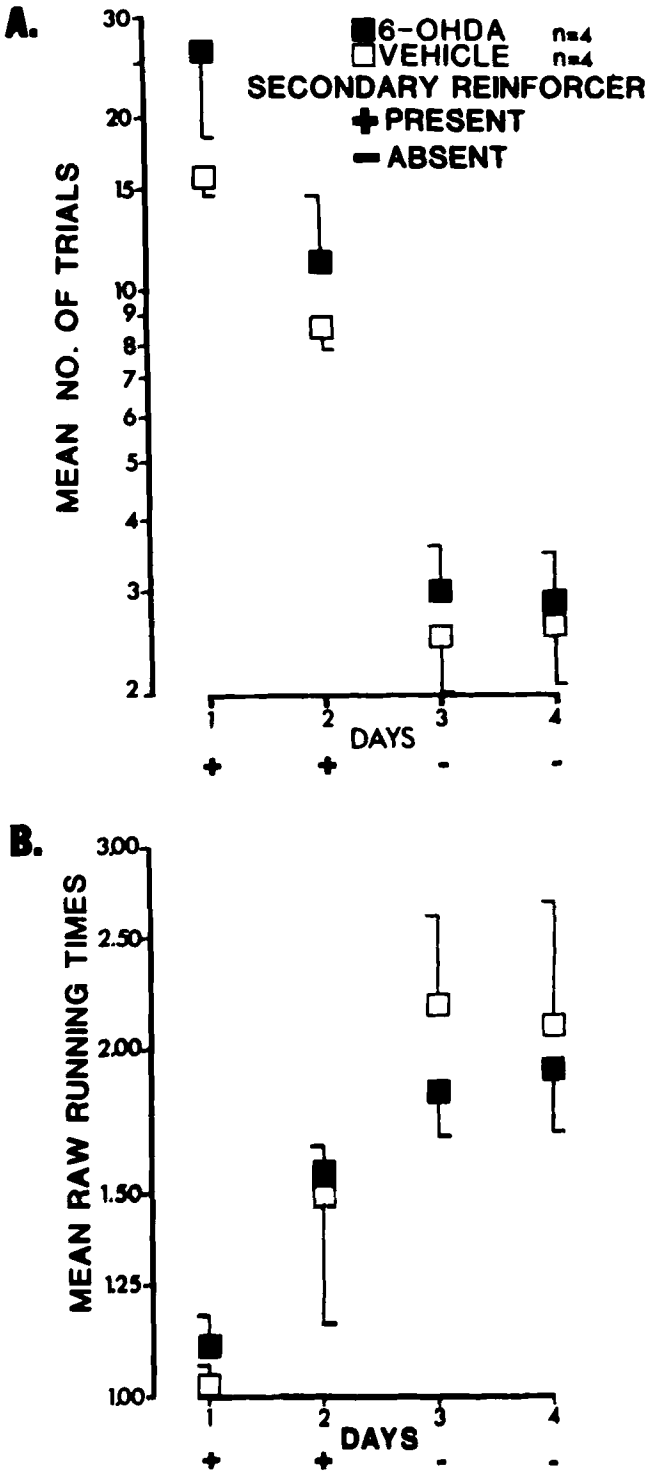


FIG. 5. Extinction behavior of REG/IRR rats revealed no significant differences in either the (A) mean number of trials (±standard error) to criterion or (B) the mean RT (±standard error) within these trials.

only in acquiring a new task, not in remembering how to perform an already learned task. Gilbert [19, 20, 21], in an extension of the proposed coeruleo-cortical theory of learning [9, 10, 11], has proposed that NE released from another bifurcating projection of the LC performs a similar function

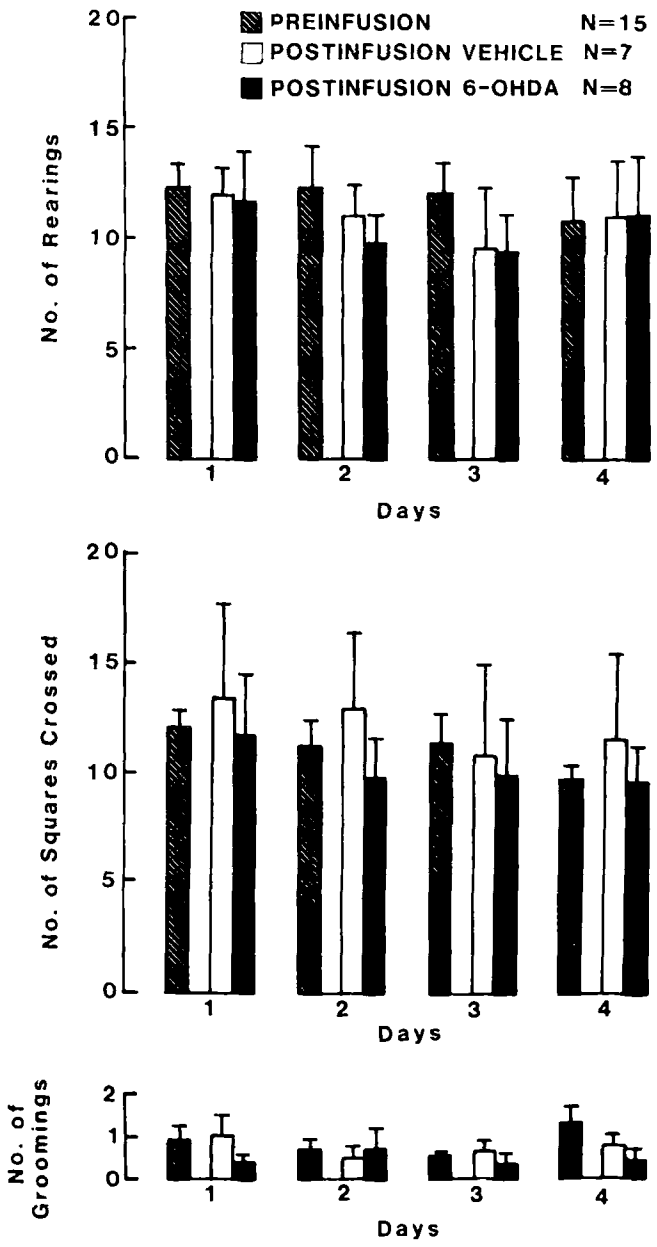


FIG. 6. Pre- and post-infusion open field activity of REG/IRR rats observed concurrently with runway testing. No significant differences were seen in either the number rearings, squares crossed or grooming (±standard error) episodes.

in the cerebellar cortex, and is thus necessary for motor responses to be learned. Changes in the synaptic strength of parallel fibers on Purkinje cells caused by complex spikes from climbing fiber input would not be consolidated without concomitant climbing fiber input to the Purkinje cell signaling that the information to be stored was of some value to the animal.

While NE may enhance the sensitivity of cerebellar circuitry to afferent input [38], the functional significance and resulting behavioral implications have not yet been realized. The observed impairment may be consequential to the severe reduction in cerebellar NE, though many complicating factors such as possible contributory roles of catecholamines in other brain areas such as forebrain hypothalamic NE and striatal DA must be considered. For example, a more generalized learning impairment may underlie the deficit. Impaired acquisition in an L-shaped runway has been demonstrated by Anzelark *et al.* [3]. Rats with bilateral electrolytic lesions of the LC showed almost no improvement in running speed for a food reward. However, though similar effects have been observed in some cases [30,45], Amaral and Foss [1] found no significant impairment in T-maze discrimination learning after similar lesions, despite the slowed running times seen among these rats. Thus, it has been argued that impaired performance in this appetitively reinforced runway paradigm does not consitute a generalized learning deficit. In fact, it may be unique to the specific runway task, perhaps reflecting an underlying motor disturbance which limits responding [1]. Further, studies employing the specific neurotoxic 6-OHDA also provide evidence that lesioning of the ascending fibers of the DNB does not significantly impair runway performance [17, 33, 43]. Crow *et al.* [13] have suggested, in accordance with Gilbert's hypothesis [20], that learning in these rats with DNB lesions may be aided by a collateral system such as the LC innervation of the cerebellar cortex. The possibility remains that one of these colateral systems of the LC is able to sustain function after the exclusion of another [13]. Nonetheless, several studies strongly suggest the integrity of certain central noradrenergic pathways are necessary for learning [3, 27, 51], and while there is no conclusive evidence of NE involvement in generalized learning behaviors, several studies particularly where speed is concerned suggest an underlying relationship between noradrenergic systems and motor learning.

The modest reduction in limbic forebrain dopamine alone is not likely to be responsible for this apparent learning deficit. This is particularly true in view of work by Creese and Iversen [8] demonstrating the capability of relatively small quantities of brain monoamines to sustain many behavioral effects of the amphetamines. It is likely that the remaining NE (54%) would be capable of sustaining relatively normal function. Far greater depletions of cortical NE produced by intra-cerebral 6-OHDA infusion into the DNB have not been shown to produce a significant impairment of acquisition in various runway learning tasks [17,33]. In addition, NE levels were apparently not reduced enough to produce resistance to extinction which is associated with reduced NE in limbic forebrain [33,34]. However, there are reports in which this dorsal bundle extinction effect was not seen in a water reinforced learning paradigm [32]. Nonetheless there was no apparent change in ability to make proper associations between reward and performance that might be attributable to NE depletion and result in impaired performance. There was approximately a 50% decrease in the number of trials to extinction and a 50% increase in mean RT for both groups from the first to the second day. Treated rats, as well as control rats, demonstrated the ability to rapidly respond to loss of water reinforcement.

The impairment in acquisition, when rats are switched to a new locomotor task after 6-OHDA infusion, may be attributable to the severe depletion of cerebellar NE. It would seem that the 6-OHDA treated animals suffer from a decreased ability to choreograph or consolidate a series of coordinated motor movements as Gilbert [20] had predicted. Though previous work by Mason and Iversen [34] suggested that profound loss of cerebellar NE did not impair the acquisition of a "complex" motor learning task, it is important to note that differences in the substrate for reinforcement, the

TABLE 1

RESULTS OF CATECHOLAMINE ASSAYS OF THE CEREBELLUM AND LIMBIC FOREBRAIN OF REG/IRR RATS AFTER INTRACISTERNAL 6-OHDA INFUSION

| Region | Control± Std. Error n=6 (ng/g wet wt) | 6-OHDA± Std. Error n=8 (ng/g wet wt) | % Controls |
|---|---|---|---|
| Norepinephrine | | | |
| Limbic Forebrain | 132.74 ± 8.28 | 71.43 ± 5.70 | 53.8† |
| Cerebellum | 120.21 ± 16.38 | 17.37 ± 1.56 | 14.5† |
| Dopamine | | | |
| Limbic Forebrain | 2276.83 ± 160.86 | 1711.60 ± 127.32 | 75.2* |

*Significant at $p<0.02$.
†Significant at $p<0.001$.

techniques of 6-OHDA administration, and the nature of the task, exist between these two studies. In addition, these neonatal rats which received peripheral 6-OHDA treatment were not subject to behavioral testing until nearly three months following the initiation of treatment. This may be of some consequence in view of data suggesting the development of post-denervation supersensitivity following 6-OHDA treatment [31, 49, 50, 55]. However, there is evidence that changes in binding characteristics associated with supersensitivity do not occur in the cerebellum when determined two weeks after LC lesioning [46].

Since no significant differences in nocturnal spontaneous locomotor activity or in open field exploratory behavior were found, it is unlikely that a generalized reduction in non-goal-directed spontaneous activity might account for the impairment. Similarly, if relative differences in motivation, resulting from possible underlying differences in the relative degree of water deprivation or other factors can be considered to play a significant role, a difference in the intertrial interval would have been expected to occur as well. Yet no such differences were observed in this latency between successive trials.

Differences in relative distractibility, may also have conceiveably played a role in this impairment. While previous reports [32, 36, 43] have suggested a role for NE in attentional processes, a recent study failed to demonstrate increased distractibility to acoustic stimuli in water reinforced, NE depleted rats [12]. Also, in cases where increased distractibility was demonstrated, far greater depletions of forebrain NE were attained. Since consistent undivided attention must be maintained for a rat to perform the REG task and especially the IRR task, it appears unlikely that distractive stimuli alone might be responsible. It is difficult to attribute an attentional effect specific only to the REG/IRR rats, since both REG/REG and IRR/IRR rats showed no impairment.

In summary, the impaired acquisitional performance observed among 6-OHDA lesioned (REG/IRR) rats when switched to the new IRR task following intracisternal infusion, is likely the result of a specific effect involving motor systems, rather than the result of motivational or attentional factors or gross motor disturbances. While further study has been undertaken to determine if the observed runway deficit is solely the result of NE deafferentation of the cerebellum, the present data is compatible with the hypothesis that NE released at cerebellar Purkinje cells facilitates the acquisition, not post-acquisitional performance, of certain coordinated motor behaviors.

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