Position response preference following unilateral brain ablation in monkeys¹

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Abstract

Monkeys with surgical removal of the right hemisphere showed an ipsilateral position response preference greater than normal animals or animals with partial, right, prestriate-temporal decortications. While other factors may contribute to this bias, a visual field defect of homonymous hemianopsia appears to be primarily related to the performance reported.

Problem

Position response bias has been reported for unilateral occipital lobectomized monkeys (Harlow, 1939; Settlage, 1939), for hemicerebrectomized monkeys (Krupe et al, 1964), and for unilaterally brain damaged humans (Costa et al, 1965). In each of the cited experiments, a visual field defect was considered to have been at least partly responsible for the bias.

Position response bias will lower scores on certain discrimination tasks. Consequently, hemicerebrectomized monkeys (with unilateral removal of all cerebral structures rostral to the midbrain) were studied to compare the degree of their ipsilateral position response preference to that of normal monkeys and monkeys with unilateral decortications that do not cause homonymous hemianopsia.

Method

The Ss were 19 monkeys (*Rhesus, macaca mulatta*) that were undergoing an extensive series of tests designed to evaluate certain behavioral effects of selected unilateral brain lesions. All were preadolescent males weighing from 5-1/2 to 7-1/2 lbs at the beginning of testing. Six had right hemicerebrectomy (H group), six were decorticated by subpial suction of prestriate and temporal lobe areas of the right hemisphere (PST group), and five were normal controls (N group). Two operated control animals with right occipital lobectomy (O group) were also studied. Drawings of the extent of intended lesions appear in Fig. 1.

Data from three tests relevant to the question of position response bias are reported here. The first test was a thickness discrimination using two 3 in square, black, wooden blocks differing only in thickness (1/2 vs. 1/4 in). Fifty trials were given each day with the position of reward (raisin or other food) appropriately randomized. Criterion level was 80% correct on two successive days.

The second task was a brightness discrimination with procedures identical to the first problem. The objects used here were 3 in square, gray, wooden blocks having either a black or white 1-1/2 in square

Fig. 1. Position response preference shown as the percentage of right-sided responses for the first two tests.

centered on the top surface.

The last problem, the patterned string test (Harlow & Settlage, 1934), has been shown to be especially sensitive to the effects of visual field defects upon position response preference. Each of four patterns was presented in a different order, four times each day for a total of 160 trials. The usual food rewards were attached randomly to the distant end of either the left or right string (light-weight chain).

In each of the three tests a non-correction procedure was followed, scoring only the first object or string moved. The primary data for this report include all responses, both correct and incorrect, to a single side. Unless otherwise stated, the Mann-Whitney U procedure was used as the test of significance.

Results

Figure 1 shows a clear right-sided position bias for both the hemicerebrectomized and occipital lobectomized Ss on the first test. Differences between H group and either N- or PST group were in the predicted directions and statistically significant (.002 and .001, respectively). A lack of difference between O- and PST groups was contrary to expected results, but O group

Fig. 2. Position response preference shown as the percentage of right-sided responses on the patterned strings test.

differed from the N Ss at the .047 level. Between groups H and O, and groups N and PST, differences were nonsignificant. Performance by the H Ss, as reflected in error scores, was poorer than either N- or PST groups (.002). Error scores for the O group differed only from normal Ss (.047).

On the second test, significant differences between groups on right position response preference were not found. Moreover, the Kruskal-Wallis one-way analysis of variance showed no statistically significant differences in error scores among H-, PST- and N groups.

On the third task, the H group once again responded with significantly more bias than either the N- or PST group ($< .05$). Neither N vs. PST nor H vs. O groups differed significantly in position bias. PST and O Ss differed on this task (Randomization Test, exact p of .0357), but contrary to expectation N and O groups did not. While the two O Ss did not differ from H Ss regarding position bias, their error scores were lower (.036). The hemisectomized animals made fewer correct responses than normal animals (.041) but did not differ from the PST group.

Discussion

A poor performance on the discrimination tasks could arise from errors other than those attributable to position response preference, e.g., object preference, memory deficit or an alternation tendency. However, a strong relationship between homonymous hemianopsia

and performance is clearly suggested by the ipsilateral position bias of both H- and O groups, when their performance was poorer than that of N and PST Ss.

A similar relationship, of various field defects and response bias, has been demonstrated in the performance of eight humans with left lesions and 19 with right-sided damage, on the Ravens Coloured Progressive Matrices tests (Costa et al, 1965). In a group with left lesions and field defects, 40% of the Ss had a left preference, whereas with left lesions and no field defects, only 14.9% showed a left bias. For the right lesioned Ss, results were more dramatic. With field defects, 72.2% of the latter group had a right preference, while 40% having lesions with no field defects showed right preference. Unlike the patients without field defects, the PST monkeys showed only a fleeting position bias, that was not convincingly related to the laterality of damage.

The reappearance of the bias in H group but not in O group, on task three suggests either, (a) more permanent deficit in the H Ss, or (b) the contribution of other factors besides field defect per se, such as circling and eye deviations, which are sometimes found in H Ss.

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Note

1. This work was supported by grants NB-01601-07 and NB-K3-16,610 from NINDB of U. S. Dept. HEW. The authors thank S. Yamaguchi for surgical assistance and E. Krimmer, T. Ellis and D. Gwillim for technical aid throughout these experiments.