Technical Papers

Handedness in the Rhesus Monkey

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The purpose of the observations reported in this paper was to determine the degree of hand preference and the distribution of the right- and left-handedness in a sample of 84 adolescent and mature rhesus monkeys (*Macaca mulatta*).

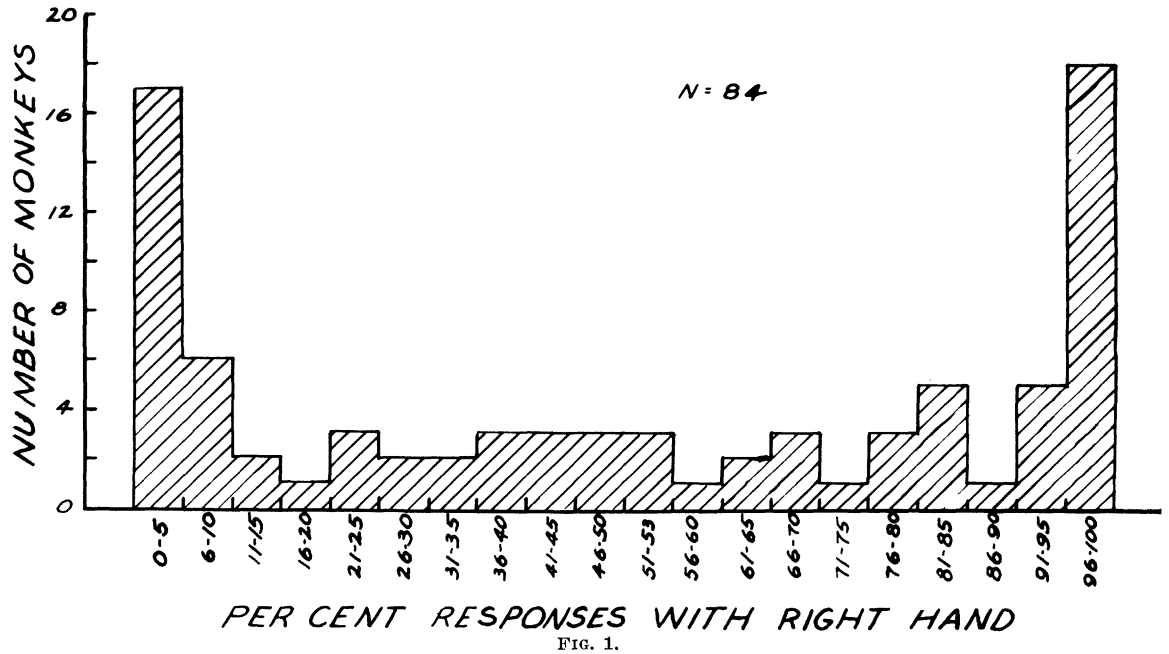

FIG. 1.

All the subjects were tested in the Wisconsin General Test Apparatus ([*1*], Fig. 1), which consists of a restraining cage, table, and superstructure supporting an opaque screen in front of the subject, and a one-way vision screen in front of the experimenter. On the table is a movable Klüver formboard, 30 by 8 in., with three food wells spaced 6 in. apart in the center of the board, the two extreme food wells being 12 in. from the edges of the formboard. The board was divided into six sections, right-, left-, and centerfront, and rear, by a line bisecting the formboard horizontally, and by two lines drawn vertically to the right and left of the extreme food wells.

Each test trial began with the forward screen lowered in front of the subject. The experimenter placed a single piece of food (peanut, apple, grape, or raisin) in one of the six sectors, lowered the one-way screen, raised the opaque screen, pushed the tray forward, and observed which hand the monkey used to pick up the food. Twenty-four such presentations were made daily, with four pieces being given in each of the six sectors in random sequence, for five days. Thus, a total of 120 responses were obtained from each animal.

The results are given in Fig. 1, a histogram showing the number of animals exhibiting the degrees of *right*-handedness indicated on the abscissa. It can be seen that 46 of the 84 monkeys used one hand (23 right, 23 left) in more than 90% of the trials, and that 53 used one hand (27 right, 26 left) in more than 80% of the 120 trials.

The results of the present experiment, in spite of the relatively small number of trials obtained from individual subjects, may be compared with those reported by Finch (*2*), who tested 31 chimpanzees for 800 trials in four different situations. Table 1 compares Finch's chimpanzee results with the rhesus monkey results of

TABLE 1

A COMPARISON OF HAND PREFERENCE IN MONKEYS AND CHIMPANZEES

	Per cent of monkeys	Per cent of chimpanzees (*2*)
Preferred hand used		
> 90% of trials	54.8	46.2
Right	27.4	23.1
Left	27.4	23.1
Preferred hand used		
> 80% of trials	63.1	64.1
Right	32.1	28.2
Left	31.0	35.9

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the present investigation. This table shows that the strength of hand preference is approximately equal, and that the proportion of right- and left-handedness is similar in the two species. Finch's more elaborate technique probably provided a more valid measure of hand preference than that of the present study, but there appears to be little evidence for assuming any significant difference in the degree of lateral dominance found in the rhesus monkey and the chimpanzee in so far as the experiments provided accurate measures of handedness in the two species.

Kounin (*3*) has criticized observations of the hand used for picking up food as a test of handedness, since "unnoticeable posturing and situational expediencies" render this task too unreliable for demonstrating the existence of handedness in monkeys. The results of the present investigation, however, suggest that Kounin's conclusion, based on very small samples, may perhaps have been prematurely pessimistic.

References

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Regeneration of Resected and Crossed Sciatic Nerves in Parabiotic Rats

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It is possible successfully to unite animals surgically in parabiosis. In the mammal such parabiosis will occur only if the animals are littermates. Even in the latter instance, it is found that a successful union is obtained in only 25% of the cases. Successful parabiosis is characterized by complete healing of the tissues, common circulation of the blood, and elimination of the skin suture line. By virtue of the compatibility of the tissue of these genetically similar, united animals, the suggestion was raised by Morpurgo (*1*) that resected nerves from one parabiont may regenerate into the distal sheath of the other parabiont. He claimed that there was functional connection of the newly formed nerve fibers of one rat with the muscles and skin of the other. However, his experiments did not include a study of the extent of regeneration as compared to controls, nor did he elaborate on the rate of recovery and cross-sectional fiber counts.

This series of experiments was intended to assess the phenomenon of cross nerve regeneration in a parabiotic host, to study the rate of regeneration and number of regenerating fibers, and to compare these data with that from nerve regeneration in single control animals.

TABLE 1

FIBER COUNTS OF THE SECTIONED ALBINO RAT SCIATIC NERVE

	Period of regeneration, days		Proximal nerve count		Distal nerve count	
	Av	Range	Av	Range	Av	Range
Normal	—	—	6497	6103–6864	6497	6103–6864
Control	81	50–113	7937	7817–8056	4406	3960–5272
Parabionts	56	29–91	7176	6802–8582	6317	4532–8102

The right sciatic nerves of 4 single albino rats (Wistar) were resected and reunited with tantalum wire (6-0 gage). Animals were tested daily for signs of functional recovery. At varying periods of time, these animals were sacrificed and the proximal and distal segments of the regenerated nerve were prepared for nerve fiber counts. Four littermate pairs of rats of the same strain were placed in lateral parabiosis (*2*). At the same time the sciatic nerves of the adjacent limbs were severed. The proximal nerve stump of the left leg of the right animal was sutured with 6-0 tantalum wire to the distal sciatic nerve stump of the right leg of the left animal. The united nerve was covered with a .0025-gage tantalum foil sheath. The remaining proximal and distal resected trunks were similarly treated. These animals were observed for functional recovery and sacrificed at varying times. Fiber counts were made of the distal and proximal segments of the regenerating nerves.

The first sign of sensory recovery, as elicited by pinching the toes of the involved extremity, was noted in 35–40 days in the control animals and 28–42 days in the parabionts. Motor recovery followed this period by 4–7 days.

At the time the animals were to be sacrificed, electrical stimulation of the proximal segment of the regenerated sciatic nerve of one parabiotic animal showed the same intensity of response in the opposite member as was observed in control animals of the same postoperative period.

The number of fibers in the distal segment of the crossed sciatic nerve in parabiotic animals was at no time less than in the distal segments of the controls with the same regeneration time (Table 1).

In summary the following points may be stated: (*a*) the proximal segment of a severed sciatic nerve can be made to regenerate into the distal sheath of the sciatic nerve of a littermate in parabiosis; (*b*) time of functional recovery, response to pain, and response to electrical stimulation is significantly similar to that found in single uncrossed control animals; and (*c*) the number of fibers in the distal segment of the regenerating nerve in parabionts consistently shows a higher count than in the controls.

The phenomenon of crossed nerve regeneration in parabiosis adds further support to the belief that the

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