Medial Preoptic Lesions and Male Sexual Behavior: Age and Environmental Interactions

Abstract. *In all species studied, the medial preoptic area has been found to be necessary for male copulatory behavior. No recovery of sexual function from the medial preoptic area lesions appears to have been reported. This study demonstrates that rats with large lesions of the medial preoptic area exhibit adult male sexual behavior when the surgery is performed prepuberally and the rats have interacted socially with peers.*

Lesions in the medial preoptic area (MPOA) impair male sexual behavior without producing testicular atrophy in guinea pigs (*1*), rats (*2*), dogs (*3*), cats (*4*), domestic fowl (*5*), and frogs (*6*). No procedure has been reported to our knowledge that enables animals with such lesions to recover their sexual capabilities. In the study described herein, large lesions were placed in the MPOA in prepuberal and adult rats living alone or with eight other animals. Prepuberal animals living alone and adult animals living alone or in groups bearing MPOA lesions manifested deficits in sexual behavior. In contrast, prepuberal animals with large MPOA lesions living in groups exhibited all of the male copulatory behaviors shown by control animals.

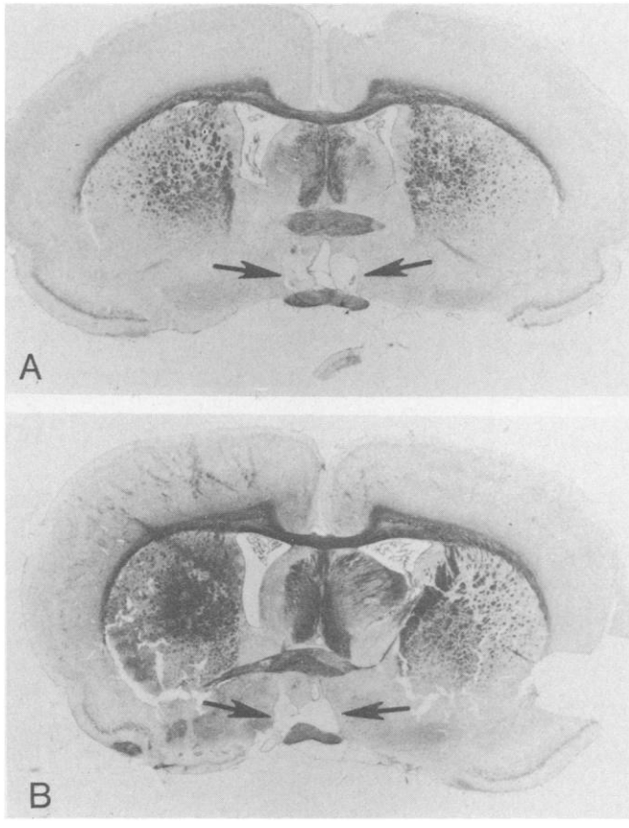

Fig. 1. Photomicrographs of brain sections containing bilateral lesions made in the MPOA of (A) a prepuberal animal living with other animals, and (B) a prepuberal animal living under solitary conditions.

We used a total of 60 prepuberal male rats (*7*). The rats were placed into one of four groups as follows: animals with bilateral lesions in the MPOA and living alone (solitary) (group 1) or with other animals (social) (group 2), and animals with sham operations and living alone (group 3) or with others (group 4).

Rats that received the MPOA lesions at 28 to 32 days of age had a 0.8-mA anodal d-c current passed for 20 seconds through a Teflon-coated platinum iridium electrode (0.33 mm in diameter). The 0.5 uninsulated tip was located 0.2 mm anterior to bregma, 0.5 mm lateral to the center of the superior sagittal sinus, and 7.8 mm below the dura (*8*). Rats receiving the sham operation were subjected to the same anesthetization, operation, and stereotaxic procedures, but the electrode was lowered only 4.0 mm below the dura, which is above the MPOA, and no current was delivered. The cages for social animals measured 58 by 58 by 29 cm and contained one 200-day-old intact female, two 30-day-old females, and three animals with MPOA lesions or sham operations. Socially isolated animals lived alone in a smaller cage (24.5 by 18 by 18 cm). All cages were placed in an air-conditioned room maintained at 21°C and on an illumination cycle of 12 hours of light and 12 hours of darkness. The first of three weekly mating tests was initiated when the animals were 58 days old. Each male was placed in a semicircular mating arena, and after 5 minutes an ovariectomized female, induced into estrus by injections of 6.6 μg of estradiol benzoate and 0.5 mg of progesterone, was put in the same arena. Mounts, intromissions, and ejaculations were recorded on an Esterline Angus event recorder.

We used 47 adult rats (200 days old) (*7*) that copulated successfully in two weekly mating tests. Using the same apparatus as for the prepuberal animals, we placed bilateral lesions beneath the bregma, 0.6 mm lateral to the midline and 7.9 mm below the dura. For the animals receiving operations and sham operations we followed the same procedure as that for the prepuberal males. The cages for social animals contained one 200-day-old female, two 90-day-old females, and three animals with MPOA lesions or three with sham operations.

Fig. 2. Mean number of mounts, intromissions, and ejaculations displayed by male rats reared under social or solitary conditions and with lesions in the MPOA made prepuberally.

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Three weekly mating tests were initiated 2 weeks after the operations. The testing procedure was identical to that used with the prepuberal animals except it lasted 20 instead of 30 minutes.

About 1 week after the last behavioral test the animals were killed by perfusion. The perfused brains were fixed and embedded in paraffin before being serially sectioned at 10 μm and stained with cresyl violet and luxol fast blue. The outline of each lesion was traced on serial drawings of the brain. The location of each lesion was determined without knowledge of the animal's experimental condition. The extent of the lesion was approximated from these tracings. A typical MPOA lesion in a socially maintained prepuberal male that copulated and one in a socially isolated male that did not are shown in Fig. 1, A and B, respectively.

Whereas no prepuberal animals with more than half of their MPOA destroyed mated if they lived alone, 85 percent did so if they lived in groups. Approximately 90 percent of the social and solitary prepuberal animals that received sham operations exhibited mounts and intromissions on each of the three mating tests. The mean numbers of posterior mounts, intromissions, and ejaculations exhibited by males with confirmed bilateral MPOA lesions and by groups with sham operations are shown in Fig. 2. Analysis of variance performed on scores from these groups (MPOA-social, $N = 9$; MPOA-solitary, $N = 10$; sham-operated-social, $N = 15$; sham-operated-solitary, $N = 14$) revealed significant lesion-living environment interactions for mounts, F (1, 44) = 4.74, $P < .05$; intromissions, F (1, 44) = 7.95, $P < .01$; and ejaculations, F (1, 44) = 4.24, $P < .05$. Subsequent Newman-Keuls tests showed that solitary animals with MPOA lesions exhibited reliably fewer mounts, intromissions, and ejaculations (each $P <$ .01) than any other group. The social animals with MPOA lesions did not differ significantly on any measure from the sham-operated groups.

Analyses of variance performed on data only from animals sustaining over 50 percent destruction of the MPOA yielded the same results as reported above, with the sole exception that the interaction between the factors of lesion and living environment was not statistically significant for the number of ejaculations. Subsequent Newman-Keuls tests revealed that the solitary animals with MPOA-lesions exhibited fewer mounts and intromissions than the other groups ($P < .01$).

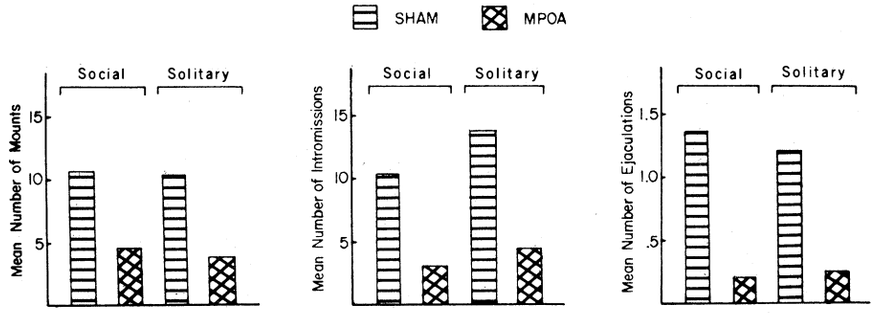

Fig. 3. Mean number of mounts, intromissions, and ejaculations displayed by male rats with lesions made postpuberally or with sham-lesions living with other animals (social) or alone (solitary).

Statistical analyses performed on data from animals having confirmed bilateral lesions in the MPOA made postpuberally showed (Fig. 3) that the social animals with MPOA lesions ($N = 9$) and the solitary animals with MPOA lesions ($N = 10$) displayed fewer copulatory behaviors than both the social and the solitary animals with sham operations ($N = 8$ and $N = 10$, respectively). A statistically significant main factor of the MPOA lesion was found for mounts F (1, 33) = 18.03, $P < .01$, intromissions F (1, 33) = 30.40, $P < .01$, and ejaculations, F (1, 33) = 93.25, $P < .01$.

Our results are consistent with many others that demonstrate that lesions of a similar size are less debilitating when made before than after puberty, and that experience influences the degree of sparing or recovery of function (*9*). Bilateral lesions of the size made in this study reliably lead to disruption of male rodent sexual behavior, and no remedial experience or treatment has been identified that enables adult animals to recover. Recently, Teitelbaum *et al.* (*10*) emphasized the parallel course of events occurring in adult animals recovering from lateral hypothalamic lesions and those in developing infants progressing from milk to solid-food ingestion. He suggested that similar processes or experiences might be required to enable unorganized neural tissue in infants and neutral or residual but temporarily traumatized neurons in animals with lesions to gain regulatory control of ingestion. This analysis provided the conceptual background for the present study. The essential sensorymotor experiences in the developing animal preceding mature copulatory behavior occur mostly during play sequences (*11*).

Prepuberal males with MPOA lesions living in groups had the essential conditions for play and were at the age when play occurs readily. All operated prepuberal animals with lesions were observed to play and most showed copulatory behaviors when adults. Similarly, solitary animals with lesions could not have had the same sensorimotor experiences and they did not copulate. Adult animals living in groups did not exhibit the same play behaviors as the prepuberal animals. If they could be induced to play then it might be anticipated that they too eventually would show recovery of sexual behavior. In general, the data are compatible with the expectations of Teitelbaum's theory of recovery of function from neural damage (*12*).

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References and Notes

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