

Effect of Preputialectomy on Fighting Behavior in Mice (34779)

TED D. MCKINNEY¹ AND JOHN J. CHRISTIAN²

Albert Einstein Medical Center, Research Laboratories, Philadelphia, Pennsylvania 19141

The preputials are modified sebaceous glands of unknown function. Absolute weight of these glands is related inversely to density in fixed populations of both albino and wild-stock male house mice (1, 2). Preputial glands also tend to be heavier in dominant as compared to subordinate males among grouped mice of a wild strain (3).

Based on the above findings, we postulated that secretions from the preputial glands influence aggressive behavior. This paper shows that fighting behavior is modified when one, but not both members of paired male mice have been preputialectomized.

Materials and Methods. Male brown house mice of a strain derived from wild mice were housed individually from 20–21 days of age to either 60–61 or 79–80 days of age in 17.5 × 25.5 × 16.5-cm steel cages. In a preliminary experiment, males 141–544 days of age were removed from bisexual pairs of which each had been a member since weaning. These animals were caged as above for 17 days.

Ten to 14 days after either preputialectomy or sham surgery, mice were paired in a cage unfamiliar to each individual. During a 15-min observation period (under red light), presence or absence of fighting, latency of attack, total fights, and accumulated attacking time (4) were recorded, and relative social rank was assigned when possible. Each preputialectomized male was paired one time with a sham-operated male. In addition, each animal was paired one time with a male of like surgical treatment. The sequence of paired encounters was random, and all pairs

were established on the basis of similar body weights.

Results. Pairs in which both members were preputialectomized and those in which both members were sham-operated did not differ for any of the behavioral parameters examined (Table I). Mean latency of attack was not significantly less in encounters involving one preputialectomized and one sham-operated male ($p < .10$), but total fights and accumulated attacking time were greater ($p < .05$ in both cases). In older males (age 141–544 days), the occurrence of fighting was increased among pairs comprised of a preputialectomized and a sham-operated animal (fighting occurred in 18 of 20 pairs of mixed surgical treatment as compared to 3 of 10 sham-operated pairs; $\chi^2 = 8.75$, $p < .005$). This effect was not apparent in other experiments, nor was the occurrence of fighting different among preputialectomized as compared to sham-operated pairs.

Preputialectomized males initiated the first attack in 45 of 71 encounters when paired with sham-operated males ($\chi^2 = 5.08$, $p < .025$). Among those pairs for which relative social rank was assigned, frequency of dominance by preputialectomized or sham-operated males did not differ significantly (preputialectomized males dominant in 38 of 64 encounters; $\chi^2 = 2.24$, $p < .10$). Data also were analyzed for possible effects on behavior due to a preputialectomized as compared to a sham-operated male being dominant (Table II). Differences between mean values were insignificant. However, variance for accumulated attacking time was significantly greater when sham-operated males were dominant ($p < .05$).

Discussion. Olfactory stimuli are of known importance in aggressive behavior of male house mice (5–7). Consistent with previous

¹ Postdoctoral Research Fellow, USPHS Training Grant MH-11285.

² Recipient of Career Development Award 2-K3-GM-15039 from USPHS.

TABLE I. Comparison of Behavior in Paired Mice: Sham-Operated Males Only (S-S), Preputialectomized Males Only (P-P), and a Preputialectomized Male Paired with a Sham-Operated Male (S-P). Values are mean \pm SE; number of pairs in parentheses.

Exp.	Latency of attack (sec)			Total fights			Accumulated attacking time (sec)		
	S-S	S-P	P-P	S-S	S-P	P-P	S-S	S-P	P-P
1 ^a	421.3 \pm 157.5 (3)	216.0 \pm 51.6 (18)	505.0 \pm 159.8 (5)	6.3 \pm 0.6 (3)	9.8 \pm 1.1 (18)	4.8 \pm 3.1 (5)	—	—	—
2 ^b	233.5 \pm 29.7 (8)	168.8 \pm 23.2 (16)	172.4 \pm 35.5 (8)	7.3 \pm 1.7 (8)	10.2 \pm 1.6 (16)	7.4 \pm 2.2 (8)	41.4 \pm 11.1 (8)	72.5 \pm 11.2 (16)	44.5 \pm 12.4 (8)
3 ^b	151.1 \pm 37.0 (10)	146.3 \pm 20.9 (20)	187.0 \pm 35.7 (8)	9.2 \pm 1.3 (10)	11.3 \pm 1.1 (20)	6.8 \pm 2.2 (8)	69.3 \pm 14.3 (10)	108.4 \pm 12.1 (20)	94.2 \pm 30.6 (8)
4 ^c	167.5 \pm 32.3 (9)	141.3 \pm 23.0 (20)	203.5 \pm 25.5 (8)	8.6 \pm 1.3 (9)	10.5 \pm 0.9 (20)	5.9 \pm 2.0 (8)	63.4 \pm 12.5 (9)	117.0 \pm 16.3 (20)	39.0 \pm 7.6 (8)

^a Age 141–544 days.

^b Age 60–61 days.

^c Age 79–80 days.

interpretation (8), we suggest that secretions from the preputial glands may have an olfactory role influencing fighting behavior in this species. Establishment of social hierarchy *per se* was not dependent upon integrity of the preputial glands in the present study, but the level of aggressive behavior was increased when preputialectomized males were paired with sham-operated males. Preputialectomized animals also tended to initiate first attacks of paired encounters but did not become dominant more often than sham-operated individuals.

If preputialectomy influenced individual aggressiveness directly, one would expect an increased level of fighting in pairs with both members having been preputialectomized. However, behavior observed in preputialectomized pairs did not differ significantly from that noted in sham-operated pairs. Effects of preputialectomy on fighting behavior, therefore, were not due to a direct influence of gland ablation on individual aggressiveness. These results indicate the possibility that behavior of a sham-operated male tended to elicit attack. Absence of olfactory stimuli normally associated with the preputial glands may have affected response of the sham-operated male to the presence of the preputialectomized animal. However, qualitative differences in behavior between preputialectomized and sham-operated males were not apparent. An alternative interpretation is that preputialectomized individuals became relatively hypersensitive to odor associated with preputial gland secretions. Odor of sham-operated males, then, may have provided an attack-eliciting stimulus to the preputialectomized males. The fact that level of aggressive behavior was independent of social rank further may indicate that the capacity to communicate relative social position was impaired in preputialectomized males.

Summary. Indices of aggressive behavior were measured in paired male house mice which previously had been preputialectomized or sham-operated. Total fights and attacking time were increased in pairs comprised of a preputialectomized and a sham-operated animal as compared to that ob-

TABLE II. Effects of Behavior Due to Dominance by a Preputialectomized (P) as Compared to a Sham-Operated (S) Male. Values are mean \pm SE; number of pairs in parentheses.

Exp.	Latency of attack (sec)		Total fights		Accumulated attacking time (sec)	
	P	S	P	S	P	S
1	249.3 \pm 81.2 (8)	122.3 \pm 44.5 (6)	10.3 \pm 3.8 (8)	9.5 \pm 1.9 (6)	—	—
2	133.5 \pm 31.5 (9)	200.7 \pm 26.9 (4)	14.0 \pm 2.3 (9)	9.0 \pm 3.5 (4)	104.2 \pm 11.3 (9)	57.2 \pm 19.5 (4)
3	134.1 \pm 31.1 (9)	169.7 \pm 29.1 (10)	10.0 \pm 1.7 (9)	12.0 \pm 1.6 (10)	100.1 \pm 14.6 (9)	107.6 \pm 19.3 (10)
4	149.1 \pm 33.9 (11)	95.1 \pm 33.1 (6)	9.8 \pm 1.5 (11)	13.0 \pm 2.4 (6)	93.1 \pm 9.3 (11)	178.5 \pm 43.4 (6)

served in sham-operated pairs. Preputialectomized males also showed a tendency to initiate first attacks of a paired encounter, but social rank was independent of presence or absence of preputial glands in an individual. Results indicate that the preputial glands influence fighting behavior, possibly through olfactory pathways.

1. Christian, J. J., *Amer. J. Physiol.* **181**, 477 (1955).

2. Christian, J. J., *Amer. J. Physiol.* **182**, 292 (1955).

3. Davis, D. E., and Christian, J. J., *Nav. Med. Res. Inst. Res. Rep.* **15**, 311 (1957).

4. Catlett, R. H., *Anim. Behav.* **9**, 8 (1961).

5. Mackintosh, J. H., and Grant, E. C., *Z. Tierpsychol.* **23**, 584 (1966).

6. Archer, J., *J. Mammal.* **49**, 572 (1968).

7. Ropartz, P., *Anim. Behav.* **16**, 97 (1968).

8. Lane-Petter, W., *Nature (London)* **216**, 794 (1967).

Received Feb. 2, 1970. P.S.E.B.M., 1970, Vol. 134.