Hormones and Behavior 1, 127-136 (1970)

# Copulatory and Aggressive Behavior in the Prepuberally Castrated Dog

BURNEY J. LE BOEUF

*Crown College, University of California, Santa Cruz, California 95060*

Prepuberal castration of male dogs did not significantly reduce mounting during development nor sexual responsiveness of the adult dog to the estrous female. Castrate males mounted frequently, vigorously, and with short latency as adults but never achieved a copulatory tie with the bitch. Aggressive behavior of castrate males was indistinguishable from that of intact males during development. In competition for estrous females, adult castrate males developed a dominance hierarchy amongst themselves as did intact males. The two groups also performed similarly in competition for bones.

The effect of castration on sexual behavior in male mammals varies with the species, the individual, and the age of the animal at the time of castration (Beach, 1947). Generally, castration in adulthood leads to a decline in sexual responsiveness to the estrous female. However, in some species, notably the cat (Rosenblatt and Aronson, 1958a) and the dog (Beach, 1952), some individuals continue to mate and show behavioral ejaculation for years after the operation.

Castration before puberty usually prevents the occurrence of the complete mating pattern in adulthood. Yet, many indications of sexual responsiveness may remain, depending on the species under investigation (Beach, 1948). Rabbits (Stone, 1932) and cats (Rosenblatt and Aronson, 1958b) exhibit only a small part of the normal behavior, whereas rats (Beach, 1942; Beach and Holz, 1946), hamsters (Warren and Aronson, 1957), guinea pigs (Seward, 1940; Sollenberger and Hamilton, 1939), bulls (Folman and Volcani, 1966) and chimpanzees (Clark, 1945) display more elements of the complete pattern, but individual variation is great.

Castration also reduces aggressive behavior in many animals, e.g., lizards, turtles, mice, rats, monkeys, and birds (Beach, 1952; Beeman, 1947; Davis, 1964; Davis and Domm, 1941; Noble and Greenberg, 1941; Scott and Frederickson, 1951; Uhrich, 1938). Androgen administration enhances dominance position in castrated chimpanzees (Clark and Birch, 1945) but not in castrated macaque monkeys (Mirsky, 1955). Most of these studies support the generalization that androgens promote aggressivity (Scott, 1962; Rothballer, 1967).

The present study was designed to investigate the effect of prepuberal castration on copulatory and aggressive behavior in the immature and the adult dog.

## METHOD

*Subjects.* Three pairs of male beagles from 3 litters obtained from the Radiobiology Laboratory at the University of California at Davis were used as Ss. At 40 days of age, the Ss were weaned and one puppy from each litter was castrated and his sibling left intact. Throughout the study, Ss were housed and fed in a 20 X 40 foot pen with six females of the same age.

Stimulus females in mating tests were 10 female beagles from the U.C. Davis colony. All were adults that had borne at least one litter and had had no previous contact with the experimental males prior to the first mating test. Tests were conducted with females in natural estrus.

## PROCEDURE

Three sets of tests and observations were conducted; the first, on immature Ss and the second and third, on the same Ss after they had reached sexual maturity. The first set of observations began when the animals were two months old and ended when they were eight months old, the age when males are capable of mating (Fuller and DuBuis, 1962). Subjects were observed in their living cages twice a week for thirty-minute periods late in the afternoon, when they were most active. Various aspects of social behavior were recorded, including: frequency and duration of mounting, fighting, and complex interactions between pairs of dogs involving chasing, growling, and biting each other lightly. This last behavior often alluded to as "play" was termed "reciprocal mouth contact" (RMC). Only interactions lasting 20 seconds or more were recorded as RMC.

The second set of observations involved mating tests with estrous females and started when the males were 9 months of age and continued until they were 18 months old. Males were tested with a female alone (Dyadic test) or with two other males and the female (Group test). Dyadic tests lasted ten minutes and began with the introduction of an estrous female into a 20 X 40 foot pen containing a male. Elements of the copulatory pattern were recorded using the criteria of Beach and Le Boeuf (1967) for scoring mating tests. The frequency and duration of the following behaviors of the male were recorded: (a) mounts with clasp and thrusts (MCT), (b) behavior of intromission characterized by rapid thrusting, pelvic oscillations, and stepping and treading, and (c) the genital lock, a completed mating in which the genitals of the pair be-

come interlocked due to the swelling of the bulbus glandis at the base of the male's penis. Castrated males were always tested before intact control males. This order of testing was dictated by the fact that intact males usually locked with the female promptly whereas the castrates did not. Since it was felt that the bitch might be less receptive to a male shortly after having locked, castrate males were run first and this possibility was avoided. Furthermore, testing for the day was terminated once the female locked, and because of this, all control animals were not tested every day. Castrate males were tested 63 times and controls, 20 times in the dyadic situation.

In group mating tests, the estrous female was introduced into a pen containing three castrate males or three intact males. These tests also lasted ten minutes, unless a lock occurred, at which time the test was terminated. Here too, the castrates were always tested first. Pushing, growling, fighting, and other indications of aggressive behavior were recorded. The castrate group was given 24 tests and the intact group, 25 tests.

The third set of observations consisted of tests devised to compare castrates with intact dogs in competition for a food-object. When eight to eleven months of age, the 6 males and their 6 female companions were given 10 "bone tests." In a test, Ss were fed approximately 20 "oxtails"–the tails of steers and horses cut into 6-inch segments–once a week in place of their regular food. The Ss competed for these bones vigorously and the tests always involved much growling and fighting. A record was kept of the frequency that an individual took a bone away from another and whether this was accomplished by threat (e.g., growling) or overt attack. Normally, most meat on the bones was eaten within one hour, after which period the test was terminated.

A second series of 10 "bone tests" was conducted when Ss were 23-24 months old. In this second series, only the 6 males were involved.

## RESULTS

*Developmental observations.* The social behavior of castrate males did not differ markedly from that of their intact littermate controls during the period between two and eight months of age. Table 1 shows the frequency that each male mounted, fought and exhibited RMC. Castrate males showed twice as many mounts as intact males. However, the great range of individual variation makes this statistic difficult to interpret. Similarly, fights and threats occurred so infrequently that it is impossible to make a meaningful comparison between the two groups. Castrate males and intact males both engaged in bouts of RMC with about equal frequency.

Mounts and RMC were not spread out evenly over the 6-month period of observations. Figure 1 shows the monthly frequency of occurrence of these two behaviors for all six dogs. RMC frequency was highest when the Ss were

TABLE 1

Frequency of Mounts, Fights, and RMC Observed in Developmental Tests

| | Castrate males | | | Intact males | | |
|---|---|---|---|---|---|---|
| Litter | Mounts | Fights and threats | RMC | Mounts | Fights and threats | RMC |
| 1 | 67 | 0 | 127 | 5 | 9 | 123 |
| 2 | 22 | 5 | 93 | 46 | 2 | 112 |
| 3 | 20 | 7 | 105 | 3 | 3 | 85 |
| Totals | 109 | 12 | 325 | 54 | 14 | 320 |

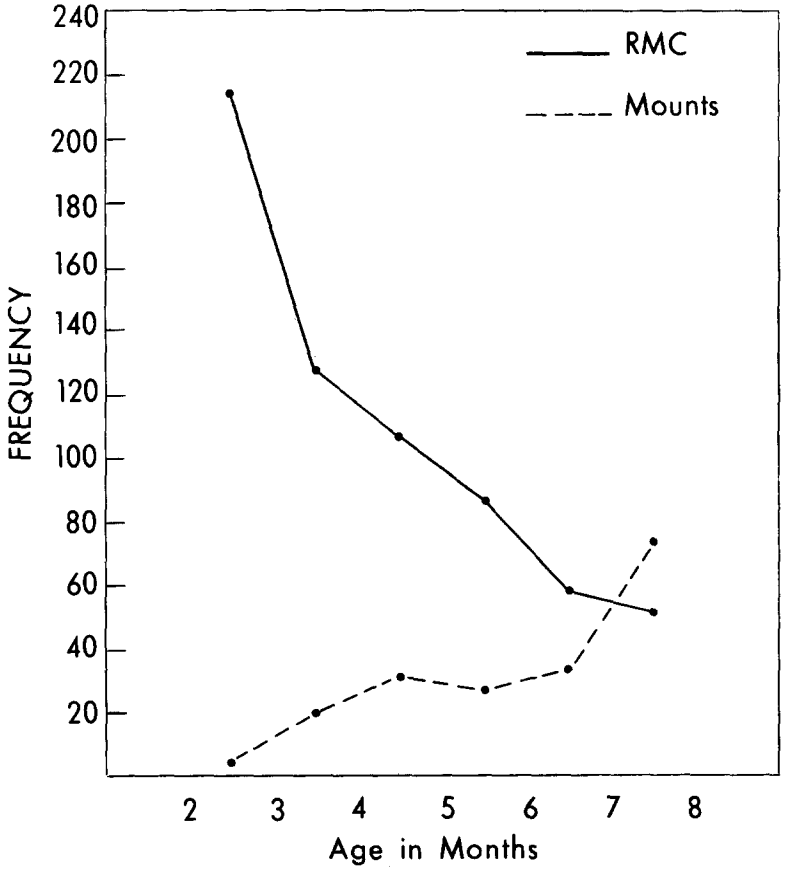


Fig. 1. Changes in RMC and mount frequency in six male dogs during the period from 2 to 8 months of age. Each point represents eight 30-minute observation periods.

young pups and decreased rapidly as they matured. The opposite was true of mount frequency; Ss mounted more and more as they grew older, reaching a high at 7-8 months of age.

Although aggressive behavior was rarely observed, it was evident by the fourth month that the largest dog, the intact male from litter one (I1), was dominant over all other males. The castrate male from litter two (C2), the third largest dog, was a clear second in rank to I1 and clearly dominated the other two intact males.

*Mating tests.* Castrate males never locked with females whereas intact males locked in 60% of the dyadic tests and 86% of the group tests (see Table 2). However, castrate males did mount females quickly and vigorously and, in both test situations, they showed a higher percentage of tests with MCT than intact males, averaging more than seven MCTs per test while intact males averaged less than four. This difference was apparently due in part to the fact that intact males could not mount while locked and hence, castrate males had more time in which to exhibit mounting.

Although castrate males never locked in any of the tests, two out of three males exhibited portions of the behavior (Beach and Le Boeuf, 1967; Beach, 1968) that normally accompanies insertion and ejaculation in intact males. C2 showed rapid thrusting 7 times (mean duration = 20 seconds) and three times he maintained an erection for one to two minutes after withdrawal. Similarly, C3 exhibited rapid thrusting 10 times (mean duration = 37 seconds). In some episodes, both males exhibited "stepping and treading" and the vertical tale posture indicative of insertion in normal males.

The mounting behavior of castrates was indistinguishable from that of intact males with one notable exception. The mean duration of MCT in each litter pair was lower for the castrate male than the intact male: Litter 1—8.4 vs 24.7 sec ($z = 21.06$, $df = 131$, $p < .05$), Litter 2—10.5 vs 17.5 sec ($z = 11.5$, $df = 70$, $p < .05$), and Litter 3—9.8 vs 13.8 sec ($z = 5.00$, $df = 147$, $p < .05$). Dogs from both groups evinced intense excitement in the presence of the estrous bitch and attempted to mount as soon as the test began. Ninety-nine percent of all mounts were correctly oriented to the female's rear. Females

TABLE 2

Copulatory Performance During Dyadic Tests and Group Tests

| Type of test | Males | No. tests | Mean MCT per test | Percent tests with MCT | Percent tests with lock |
|---|---|---|---|---|---|
| Dyadic | Castrates | 63 | 7.3 | 87 | 0 |
| | Intacts | 20 | 3.8 | 85 | 60 |
| Group | Castrates | 24 | 21.6 | 100 | 0 |
| | Intacts | 25 | 9.8 | 100 | 86 |

did not appear to distinguish between castrate males and intact males. They solicited castrate males as readily as intact males by "presenting" their hindquarters and standing still with the tail deviated to one side.

In group mating tests, castrate males competed as vigorously for females as did intact males. Within each group, one male gradually came to dominate

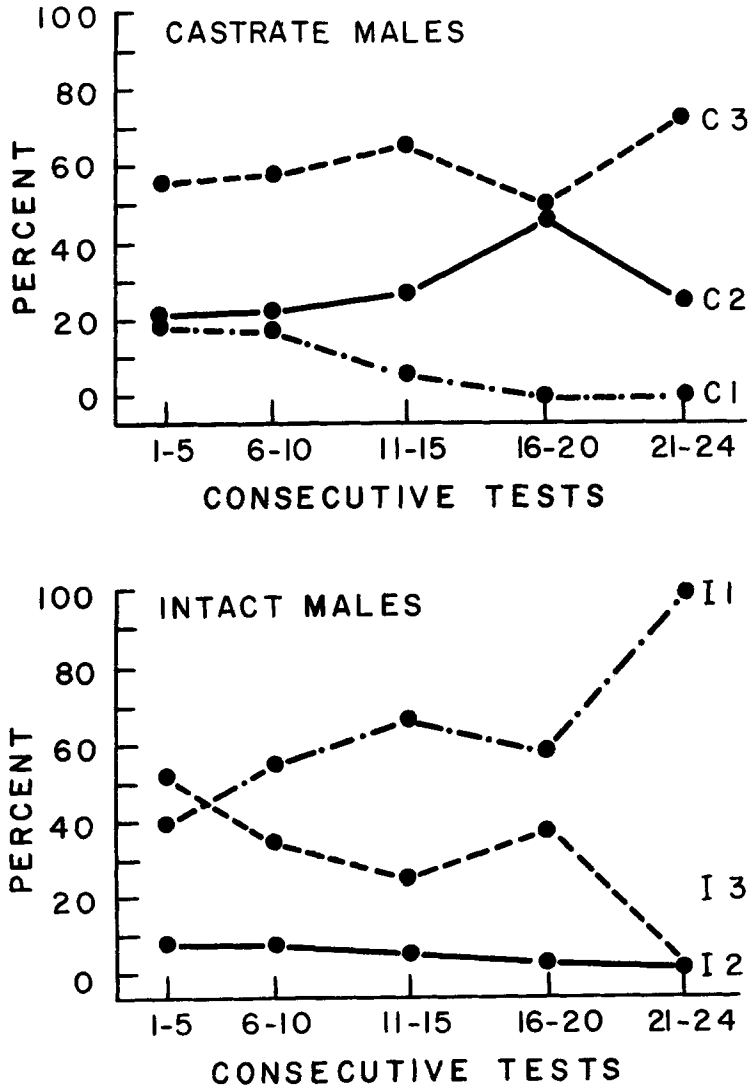


Fig. 2. Changes in the relative percentage of MCTs for each male in consecutive group tests. Each point represents one indiviausl's proportion of the total MCTs observed in a block of 4-5 tests.

the other males and would prevent them from mounting by pushing them off the female, by growling or by biting them. The dominant castrate male was C2 and the dominant intact male was I1. By the time the last group tests were conducted, the dominant male had so intimidated the other 2 males that he simply had to stare with head lowered to cause one or both other males to cringe and retreat to a corner of the pen. Figure 2 shows that C1 among the castrates and I2 and I3 among the intacts were completely inhibited from mounting in the last block of 4 tests. These same animals mounted readily in dyadic tests conducted shortly after the group tests. Thus, it appears that interindividual dominance exists in castrate as well as intact males and the form it takes is similar.

*Bone tests.* Table 3 shows the relationships that resulted when the six dogs competed for oxtails. The relationships are similar to those that were evident early in development and during group mating tests. In both series of

TABLE 3

Number of Times That One Dog Took a Bone from Another Dog by Threat or Attack

Series 1 (10 tests)

| | | Got bone | | | | | |
|---|---|---|---|---|---|---|---|
| | | I1 | C2 | I2 | C3 | I3 | C1 |
| Lost bone | I1 | – | | | | | |
| | C2 | 72 | – | | | | |
| | I2 | 47 | 1 | – | | | |
| | C3 | 12 | 9 | 5 | – | | 1 |
| | I3 | 7 | 13 | 4 | 4 | – | |
| | C1 | 2 | 2 | 8 | 3 | 2 | – |
| | | 140 | 25 | 17 | 7 | 2 | 1 |

Series 2 (10 tests)

| | | Got bone | | | | | |
|---|---|---|---|---|---|---|---|
| | | I1 | C2 | I2 | C3 | I3 | C1 |
| Lost bone | I1 | – | | | | | |
| | C2 | 103 | – | | | | |
| | I2 | 57 | | – | | | |
| | C3 | 27 | 4 | 4 | – | | |
| | I3 | 62 | 10 | 3 | | – | |
| | C1 | 12 | 13 | | | | – |
| | | 261 | 27 | 7 | | | |

tests, I1 took bones away from all others and was never challenged himself. However, the next most successful dog was the castrate, C2. The first series of tests shows that the intact males did not completely dominate the castrates since both C2 and C3 ranked higher than their intact littermate controls. Dominance relationships did not change from the first to the second series of tests. I1 became even more effective in preventing the 4 lowest ranking dogs from competing amongst themselves. This situation made it impossible to rank all dogs hierarchically.

## DISCUSSION

Early castration of male dogs seems to have little effect on sexual responsiveness, sexual attractiveness, or aggressivity. Castrate males mounted quickly and frequently and their mounts were well-executed and properly oriented. This is in marked contrast to the behavior of prepuberally castrated male cats. Rosenblatt and Aronson (1958b) reported that only one of 13 cats castrated at 4 months of age mounted the female, and he did not exhibit stepping and thrusting. Cats and dogs seem to represent the opposite extremes in adult sexual behavior that results from early castration; the former lose virtually all interest in the female whereas the latter seem to be affected less by this treatment than other mammals that have been studied. Estrous bitches solicited the attention of castrate males as often as they solicited intact males. Apparently, castration did not preclude male dogs from furnishing visual and/or olfactory stimili adequate to excite the attention of bitches.

Early castration does lead to loss of ability to lock with the bitch. This deficiency may be due in part to the smallness of the penis which fails to develop in the absence of androgenic secretions from the testes (Beach and Levinson, 1950; Eleftheriou and Stanley, 1963). The ejaculatory reflex is also lost, in most cases. On the few occasions that castrate males displayed the behavior which normally accompanies the active phase of the ejaculatory reflex in intact males, the behavior was less vigorous and less intense than that shown by intact males. This result was expected, since it is well known that the ejaculatory response is the first component of the copulatory pattern of most mammals that deteriorates following castration (Beach, 1948).

Castration did not decrease aggressive behavior substantially either in developing puppies or in adult dogs. Whether measured by frequency of social fighting or dominance position arising from competition for females or bones, the groups performed similarly. Mirsky (1955) reported a similar finding with macaque monkeys.

Although much remains to be learned about the relationship between androgens and social and sexual behavior, it can be concluded from this study that early castration does not reduce the expression of sexual libido nor does

it noticeably inhibit fighting in dogs. It does, however, effectively prevent complete copulations.

ACKNOWLEDGMENTS

I thank Dr. Leo Bustad, Director, Radiobiology Laboratory, University of California at Davis, for providing the animal subjects and testing facility, Dr. Amy Hosein for conducting the surgery, and Margaret Miller for technical assistance.

REFERENCES

Beach, F. A. (1942). Copulatory behavior in prepuberally castrated male rats and its modification by estrogen administration. *Endocrinology* **31**, 679-683.

Beach, F. A. (1947). A review of physiological and psychological studies of sexual behaviour in mammals. *Physiol. Rev.* 27, 240-307.

Beach, F. A. (1948). *Hormones and behaviour.* New York: Paul B. Hoeber.

Beach, F. A. (1952). Sex and species differences in the behavioral effects of gonadal hormones. In: *Ciba Foundation Colloquia on Endocrinology, Vol. III: Hormones, Psychology and Behavior: Steroid Hormone Administration.* (G. E. W. Wolstenholme and M. P. Cameron, Eds.). Churchill, London, 3-17.

Beach, F. A., and Holz, M. A. (1946). Mating behaviour in male rats castrated at various ages and injected with androgen. *J. Exptl. Zool.* **101**, 91-142.

Beach, F. A., and Le Boeuf, B. J. (1967). Coital behaviour in dogs, I. Preferential Mating in the Bitch. *Amin. Behav.* **15**, 546-558.

Beach, F. A., and Levinson, G. (1950). Effects of androgen on the glans penis and mating behavior of castrated male rats. *J. Exptl. Zool.* **114**, 159-171.

Beeman, E. A. (1947). The effect of male hormones on aggressive behavior in mice. *Physiol. Zool.* **20**, 373-405.

Clark, G. (1945). Prepuberal castration in the male chimpanzee, with some effects of replacement therapy. *Growth* **9**, 327-339.

Clark, G., and Birch, H. G. (1945). Hormonal modificaitons of social behaviour. I. The effect of sex-hormone administration on the social status of a male-castrate chimpanzee. *Psychosom. Med.* 7, 321-329.

Davis, D. E. (1964). The physiological analysis of aggressive behavior. In: *Social Behavior and Organization Among Vertebrates* (W. Etkin, Ed.). Univ. of Chicago Press, Chicago, 53-74.

Davis, D. E., and Domm, L. V. (1941). The sexual behavior of hormonally treated domestic fowl. *Proc. Soc. Exptl. Biol. Med.* **48**, 667-669.

Eleftheriou, B. E., and Stanley, W. C. (1963). Influence of testosterone propionate and growth hormone on the os penis in the dog. *Endocrinology* 72, 161-164.

Folman, Y., and Volcani, R. (1966). Copulatory behaviour of the prepuberally castrated bull. *Anim. Behav.* **14**, 572-573.

Fuller, J. L., and DuBuis, E. M. (1962). The behaviour of dogs. In: *The Behaviour of Domestic Animals* (E. S. E. Hafez, Ed.). The Williams and Wilkins Company, Baltimore, 415-452.

Mirsky, A. F. (1955). The influence of sex hormones on social behavior in monkeys. *J. Comp. Physiol. Psychol.* **48**, 327-335.

Noble, G. K., and Greenberg, B. (1941). Induction of female behavior in male *Anolis carolinensis* with testosterone propionate. *Proc. Soc. Exptl. Bio. Med.* 47, 32-37.

Rosenblatt, J. S., and Aronson, L. R. (1958a). The decline of sexual behavior in male cats after castration with special reference to the role of prior sexual experience. *Behavior* **12**, 285-338.

Rosenblatt, J. S., and Aronson, L. R. (1958b). The influence of experience on the behavioral effects of androgen in prepuberally castrated male cats. *Anim. Behav.* **6**, 171-182.

Rothballer, A. B. (1967). Aggression, defense and neurohumors. In: *Brain Function, Vol. V: Aggression and Defense* (C. D. Clemente and D. B. Lindsley, Eds.) University of California Press, Berkeley, 135-170.

Scott, J. P. (1962). Hostility and aggression in animals. In: *Roots of Behavior* (E. L. Bliss, Ed.). Harper, New York, 167-178.

Scott, J. P., and Frederickson, E. (1951). The causes of fighting in mice and rats. *Physiol. Zool.* **24**, 273-309.

Seward, J. P. (1940). Studies on the reproductive activities of the guinea pig: III. The effect of androgenic hormone on sex drive in males and females. *J. Comp. Psychol.* **30**, 435-449.

Sollenberger, R. T., and Hamilton, J. B. (1939). The effect of testosterone propionate upon the sexual behaviour of castrated male guinea pigs. *J. Comp. Psychol.* **28**, 81-92.

Stone, C. P. (1932). The retention of copulatory activity in male rabbits following castration. *J. Genet. Psychol.* **40**, 296-305.

Uhrich, J. (1938). The social hierarchy in albino mice. *J. Comp. Psychol.* **25**, 373-413.

Warren, R. P., and Aronson, L. R. (1957). Sexual behaviour in adult male hamsters castrated-adrenalectomized prior to puberty. *J. Comp. Physiol. Psychol.* **50**, 475-480.