Scientific research studies that found spaying and neutering do not reduce aggression in dogs

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Michelle Bamberger, MS, DVM, and Katherine A. Houpt, VMD, PhD, DACVB
Signalment factors, comorbidity, and trends in behavior diagnoses in dogs: 1,644 cases (1991–2001)
Journal of the American Veterinary Medical Association, Vol 229, No. 10, November 15, 2006

Behavioral assessment of child-directed canine aggression
Ilana R Reisner, Frances S Shofer, Michael L Nance
Injury Prevention 2007; 13:348–351

Deborah L. Duffy, Ph.D., and James A. Serpell, Ph.D., Center for the Interaction of Animals and Society, School of Veterinary Medicine, University of Pennsylvania
Non-reproductive Effects of Spaying and Neutering on Behavior in Dogs
Proceedings of the Third International Symposium on Non-Surgical Contraceptive Methods for Pet Population Control, 2006

Anthony L. Podberscek, James A. Serpell
Animal Welfare and Human-Animal Interactions Group, Department of Clinical Veterinary Medicine, University of Cambridge, Department of Clinical Studies, School of Veterinary Medicine, University of Pennsylvania.
Applied Animal Behaviour Science 47 (1996) 75-89
The English Cocker Spaniel: preliminary findings on aggressive behaviour

V. O'Farrell and E. Peachey
Behavioural effects of ovario-hysterectomy on bitches
Small Animal Clinic, Royal (Dick) School of Veterinary Studies, Summerhall, Edinburgh EH9 1QH
Journal of Small Animal Practice (1990) 31, 595-598

Hyeon H. Kim a, Seong C. Yeon a,, Katherine A. Houpt b, Hee C. Lee
Hong H. Chang a, Hyo J. Lee
Institute of Animal Medicine, College of Veterinary Medicine, Gyeongsang National University, Jinju 660-701, Republic of Korea
Animal Behaviour Clinic, College of Veterinary Medicine, Cornell University, Ithaca, NY 14853-6401, USA
Effects of ovariohysterectomy on reactivity in German Shepherd dogs
The Veterinary Journal 172 (2006) 154–159

PRESENTATION SUMMARY & POWERPOINT

Non-reproductive Effects of Spaying and Neutering on Behavior in Dogs

Deborah L. Duffy, Ph.D., and James A. Serpell, Ph.D., Center for the Interaction of Animals and Society, School of Veterinary Medicine, University of Pennsylvania

Although there are scattered reports in the literature of apparently adverse effects of spaying and neutering on canine behavior, there are very few quantitative studies and most of these have employed behavioral measures of unknown reliability and validity.

The present study used the Canine Behavioral Assessment and Research Questionnaire (C-BARQ)© to investigate the impact of spaying/neutering in various dog populations, including (1) a random sample of 1,552 dogs belonging to 11 common breeds and (2) a convenience sample of over 6,000 dogs of various breeds recruited via an online survey. The C-BARQ is a reliable, standardized method for evaluating and screening dogs for the presence and severity of behavioral problems. It was developed by behavioral researchers at the University of Pennsylvania (Hsu and Serpell, 2003) and consists of a 101-item questionnaire that is simple to use, takes about 15 minutes to fill out, and can be completed by anyone who is reasonably familiar with the dog's typical responses to ordinary, day-to-day events and stimuli. The C-BARQ is currently the only existing behavioral assessment instrument of its kind to be thoroughly tested for reliability and validity on large samples of dogs of various breeds. This process has resulted in the identification of the following 13 distinct behavioral factors or traits that are common to the majority of dogs, regardless of breed, age, sex or neuter status:

1. **Stranger-directed aggression:** Dog shows threatening or aggressive responses to strangers approaching or invading the dog's or the owner's personal space, territory, or home range.

2. **Owner-directed aggression:** Dog shows threatening or aggressive responses to the owner or other members of the household when challenged, manhandled, stared at, stepped over, or when approached while in possession of food or objects.

3. **Dog-directed fear/aggression:** Dog shows fearful and/or aggressive responses when approached directly by unfamiliar dogs.

4. **Familiar dog aggression:** Threatening or aggressive responses during competition for resources with other (familiar) dog(s) in the household.

5. **Stranger-directed fear:** Fearful or wary responses when approached directly by strangers.

6. **Nonsocial fear:** Fearful or wary responses to sudden or loud noises, traffic, and unfamiliar objects and situations.

7. **Separation-related behavior:** Vocalizes and/or engages in destructive behavior when separated from the owner, often accompanied or preceded by behavioral and autonomic signs of anxiety, including restlessness, loss of appetite, trembling, and excessive salivation.

8. **Attachment and attention-seeking:** Maintains close proximity to the owner or other members of the household, solicits affection or attention, and becomes agitated when the owner gives attention to third parties.

9. **Trainability:** Shows willingness to attend to the owner, obeys simple commands, fetches objects, responds positively to correction, and ignores distracting stimuli.

10. **Chasing:** Pursues cats, birds, and other small animals, given the opportunity.

11. **Excitability:** Strong reaction to potentially exciting or arousing events, such as going for walks or car trips, doorbells, arrival of visitors, and the owner arriving home; difficulty settling down after such events.

12. **Touch sensitivity:** Fearful or wary responses to potentially painful procedures, including bathing, grooming, claw-clipping, and veterinary examinations.

13. **Energy level:** Highly energetic, boisterous, and/or playful behavior.

The results of the study suggest that spayed female dogs tend to be more aggressive toward their owners and to strangers than intact females, but that these effects of spaying on behavior appear to be highly breed-specific. Contrary to popular belief, the study found little evidence that castration was an effective treatment for aggressive behavior in male dogs, and may exacerbate other behavioral problems. Further research will be needed to clarify the relationship between age of spaying/neutering and these apparent effects on behavior.

Reference

Hsu, Y., and Serpell, J.A. 2003. “Development and validation of a questionnaire for measuring behavior and temperament traits in pet dogs.” *J. Amer. Vet. Med. Assoc., 223:* 1293-1300.

Session I: Non-reproductive Effects of Spaying and Neutering
Effects on Behavior
By Dr. Deborah Duffy

BEHAVIORAL EFFECTS OF SPAYING/NEUTERING IN DOMESTIC DOGS

Deborah L. Duffy, Ph.D.
James A. Serpell, Ph.D.

Center for the Interaction of Animals & Society
School of Veterinary Medicine
University of Pennsylvania

OFTEN CITED BEHAVIORAL REASONS TO SPAY/NEUTER A PET:

(from websites of veterinary clinics, humane societies, trainers & animal shelters)

"Spaying and neutering makes pets better, more affectionate companions."

"Unsterilized animals often exhibit more behavior and temperament problems than do those who have been spayed or neutered."

"Female dogs, like males, have an increased risk of aggression if left intact."

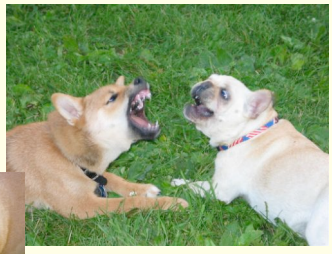
"It is true that unneutered dogs are often more aggressive and territorial (urine marking, fighting), but these traits should not be confused with loyalty and protection of their home and family."

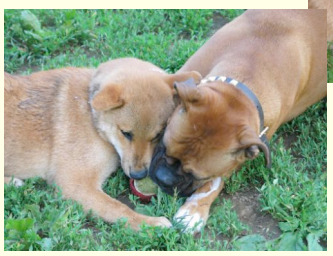
"The only behavior changes that are observed after neutering relate to behaviors influenced by male hormones."

"..any (behavioral) change would be for the better. Altered pets are less aggressive toward other dogs and cats, are less likely to urine mark and wander, and generally have better personalities."

QUESTIONS:

- What effects does spaying/neutering have on non-reproductive behaviors?
- Sex differences?
- Breed differences?





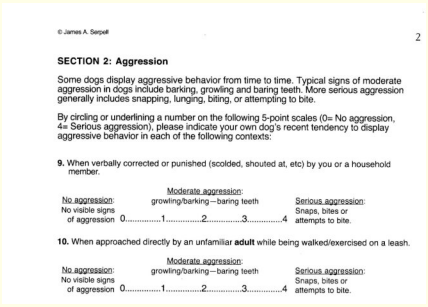
C-B-A-R-Q

Canine Behavioral Assessment & Research Questionnaire (*C-BARQ*)

http://www.vet.upenn.edu/cbarq/

101 Questions:

- 5-point scale
- mixture of severity scales and frequency scales



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SECTION 2: Aggression

Some dogs display aggressive behavior from time to time. Typical signs of moderate aggression in dogs include barking, growling and baring teeth. More serious aggression generally includes snapping, lunging, biting, or attempting to bite.

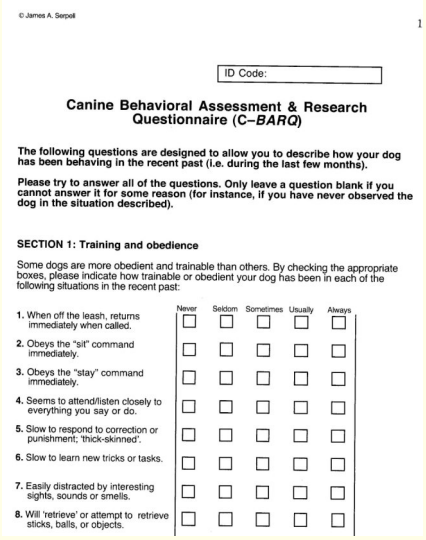
By circling or underlining a number on the following 5-point scales (0= No aggression, 4= Serious aggression), please indicate your own dog's recent tendency to display aggressive behavior in each of the following contexts:

9. When verbally corrected or punished (scolded, shouted at, etc) by you or a household member.

No aggression:	Moderate aggression: growling/barking—baring teeth			Serious aggression:
No visible signs of aggression	0 ..... 1 ..... 2 ..... 3			4 Snaps, bites or attempts to bite.

10. When approached directly by an unfamiliar **adult** while being walked/exercised on a leash.

No aggression:	Moderate aggression: growling/barking—baring teeth			Serious aggression:
No visible signs of aggression	0 ..... 1 ..... 2 ..... 3			4 Snaps, bites or attempts to bite.



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ID Code:

Canine Behavioral Assessment & Research Questionnaire (C–*BARQ*)

The following questions are designed to allow you to describe how your dog has been behaving in the recent past (i.e. during the last few months).

Please try to answer all of the questions. Only leave a question blank if you cannot answer it for some reason (for instance, if you have never observed the dog in the situation described).

SECTION 1: Training and obedience

Some dogs are more obedient and trainable than others. By checking the appropriate boxes, please indicate how trainable or obedient your dog has been in each of the following situations in the recent past:

	Never	Seldom	Sometimes	Usually	Always
1. When off the leash, returns immediately when called.	☐	☐	☐	☐	☐
2. Obeys the "sit" command immediately.	☐	☐	☐	☐	☐
3. Obeys the "stay" command immediately.	☐	☐	☐	☐	☐
4. Seems to attend/listen closely to everything you say or do.	☐	☐	☐	☐	☐
5. Slow to respond to correction or punishment; 'thick-skinned'.	☐	☐	☐	☐	☐
6. Slow to learn new tricks or tasks.	☐	☐	☐	☐	☐
7. Easily distracted by interesting sights, sounds or smells.	☐	☐	☐	☐	☐
8. Will 'retrieve' or attempt to retrieve sticks, balls, or objects.	☐	☐	☐	☐	☐

The C-*BARQ* Factors or Traits

Stranger-directed aggression (10 items)

Owner-directed aggression (8 items)

Dog-directed fear/aggression (8 items)

Dog rivalry (4 items)

Stranger-directed fear (4 items)

Nonsocial fear (6 items)

Separation-related behavior (8 items)

Attachment/attention-seeking (6 items)

Trainability (8 items)

Chasing (4 items)

Excitability (6 items)

Touch sensitivity (4 items)

Energy (2 items)

Miscellaneous C-BARQ Items

Item 78: Escaping/roaming
Item 79: Rolling in scent
Item 80: Coprophagia (eating feces)
Item 81: Chewing objects
Item 82: Mounting
Item 83: Food begging
Item 84: Food stealing
Item 85: Fear of stairs
Item 86: Pulling on leash
Item 87: Marking with urine
Item 88: Submissive/emotional urination
Item 89: Separation urination
Item 90: Separation defecation
Item 91: Hyperactivity
Item 94: Staring (obsessive)
Item 95: Snapping at flies (obsessive)
Item 96: Tail-chasing
Item 97: Shadow/light-chasing
Item 98: Barking
Item 99: Autogrooming (self)
Item 100: Allogrooming (others)
Item 101: Other abnormal/stereotypic

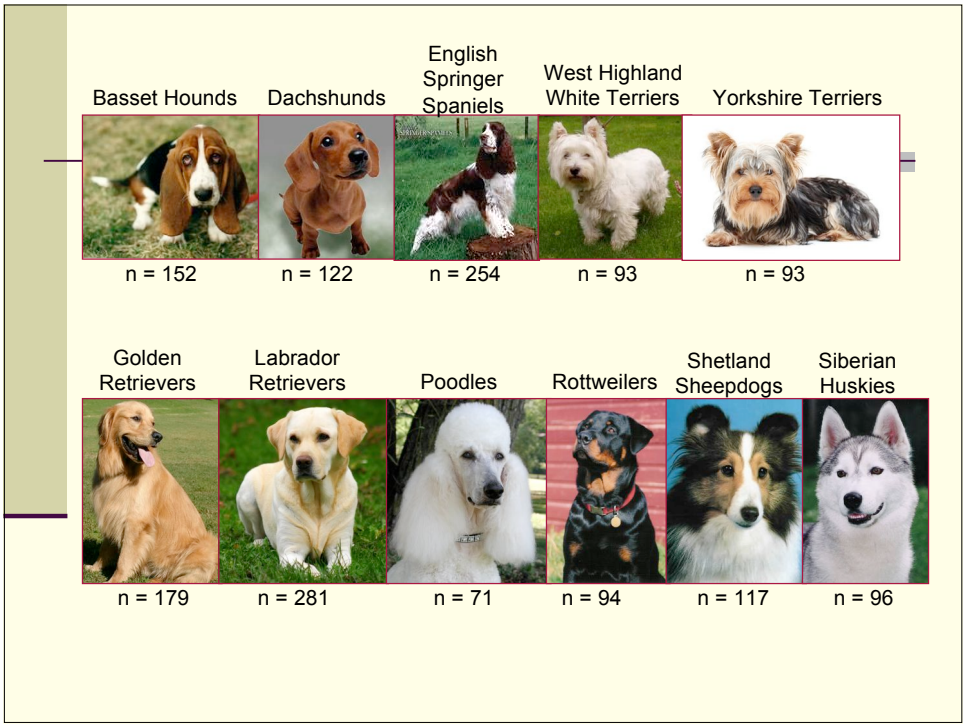
Random Sample Survey

Respondents:

- 1,552 dog owners (breed club members)

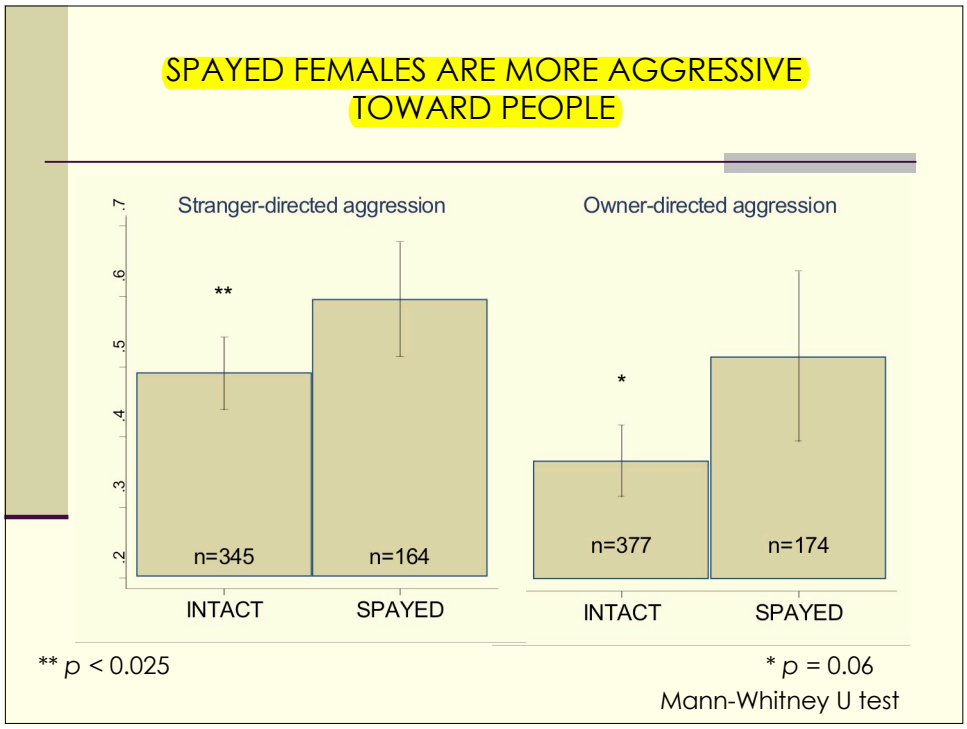
Dogs

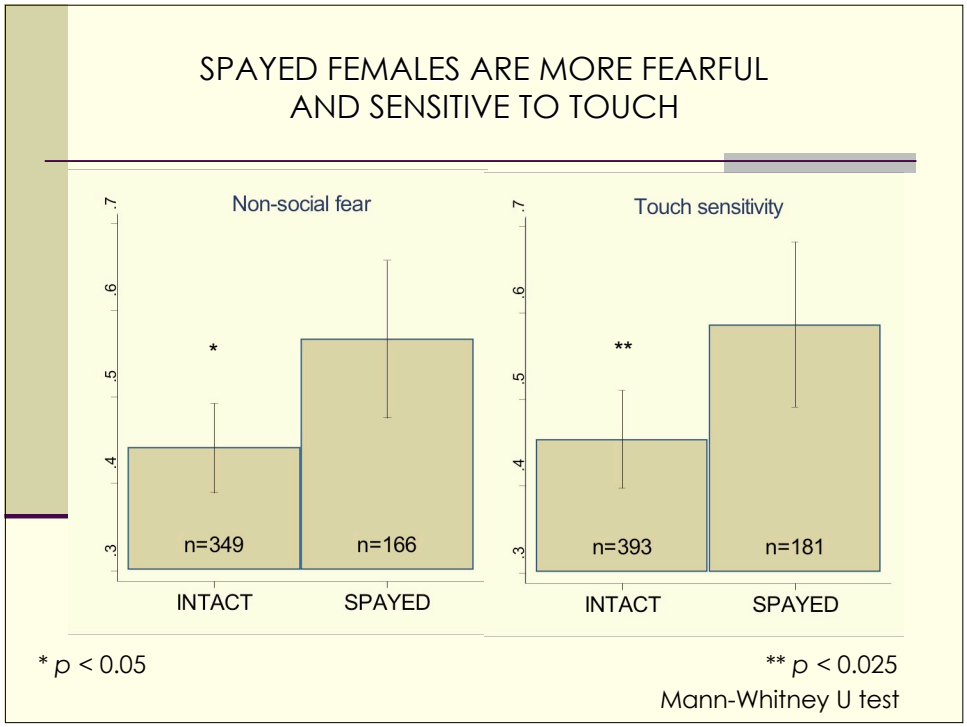
- Age: ≥ 1 year old (mean 6 years, Std.dev. 3.2 yrs)
- Sex: Male:Female ratio = 1:1
- 40% Spayed/Neutered

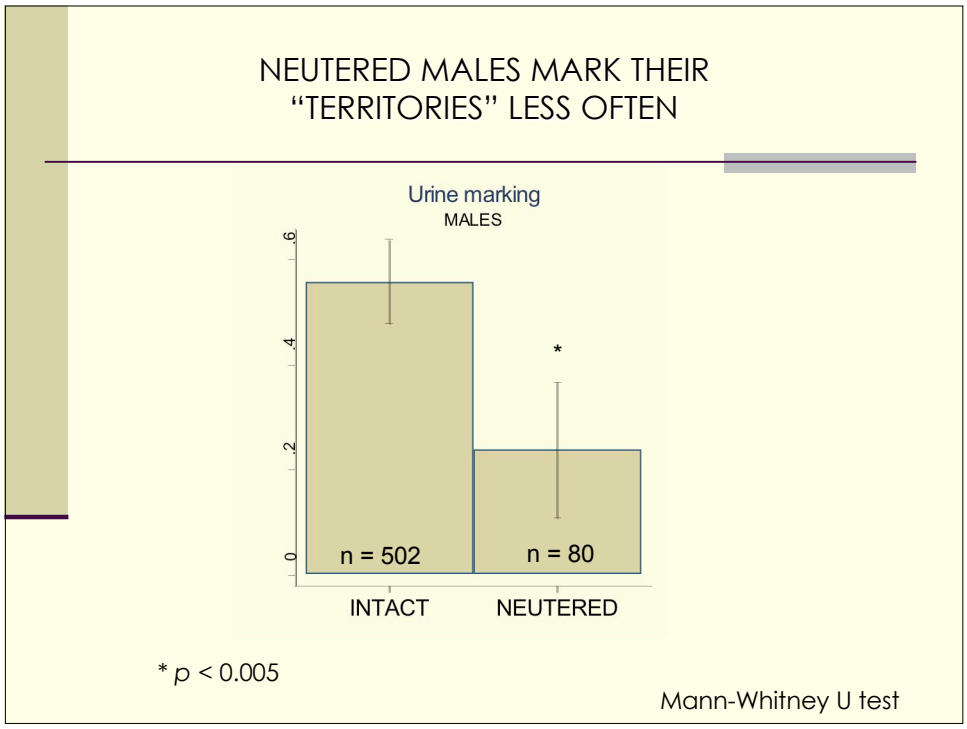


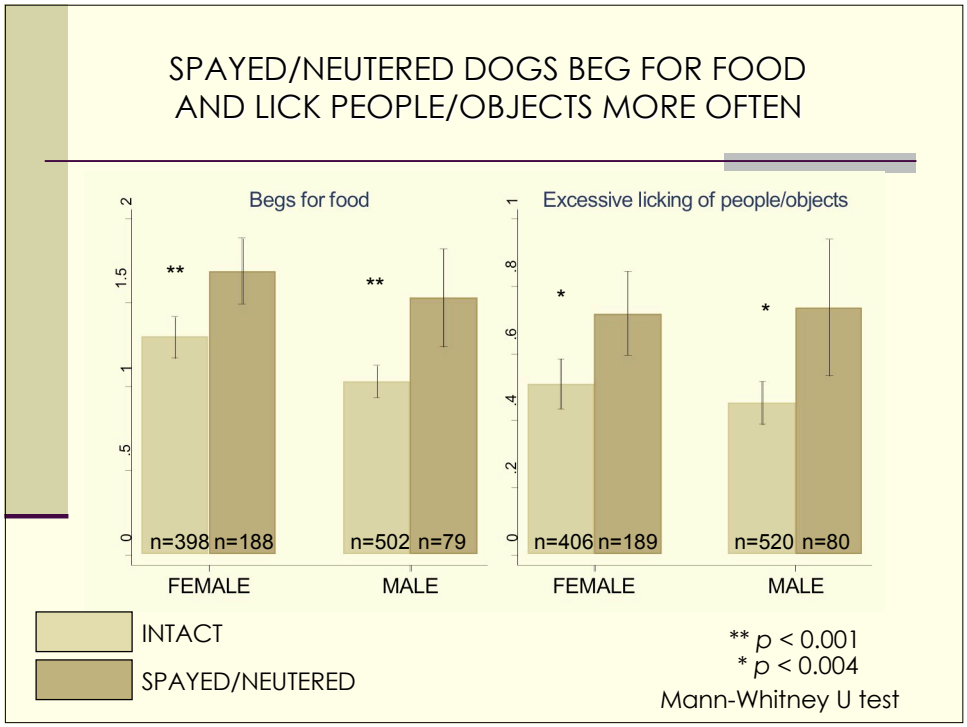
Reasons for Spaying/Neutering:

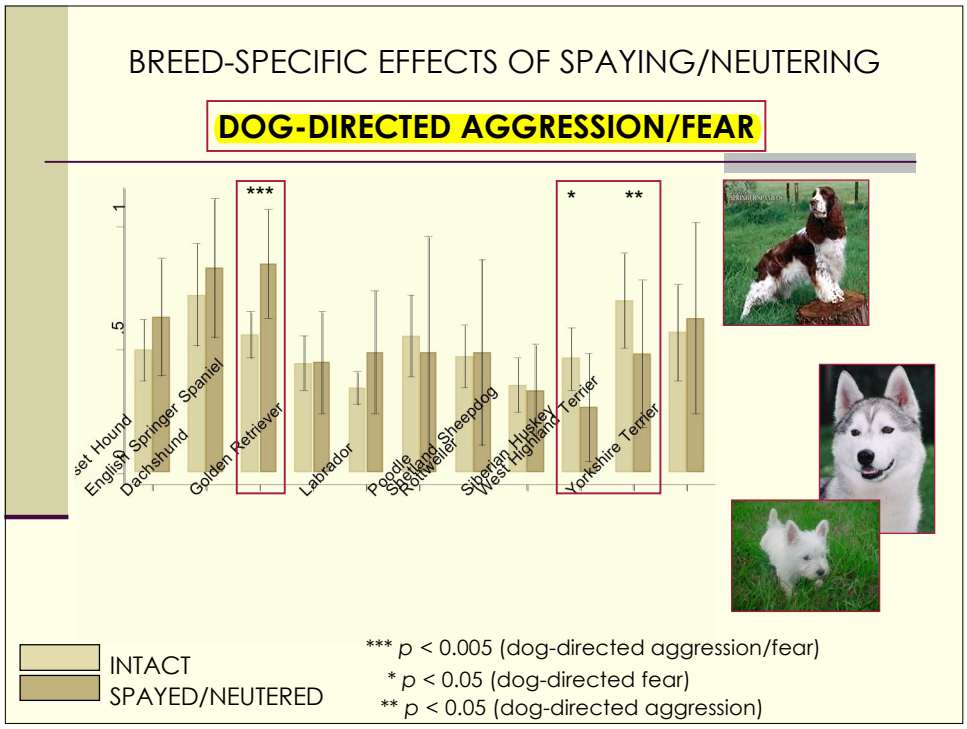
	Percent
Birth Control	41.8
Required by Shelter/Breeder	2.2
Control/Prevent Behavior Problems	18.1
Control/Prevent Health Problems	31.4
Recommended by Veterinarian	.5
Other	6.0

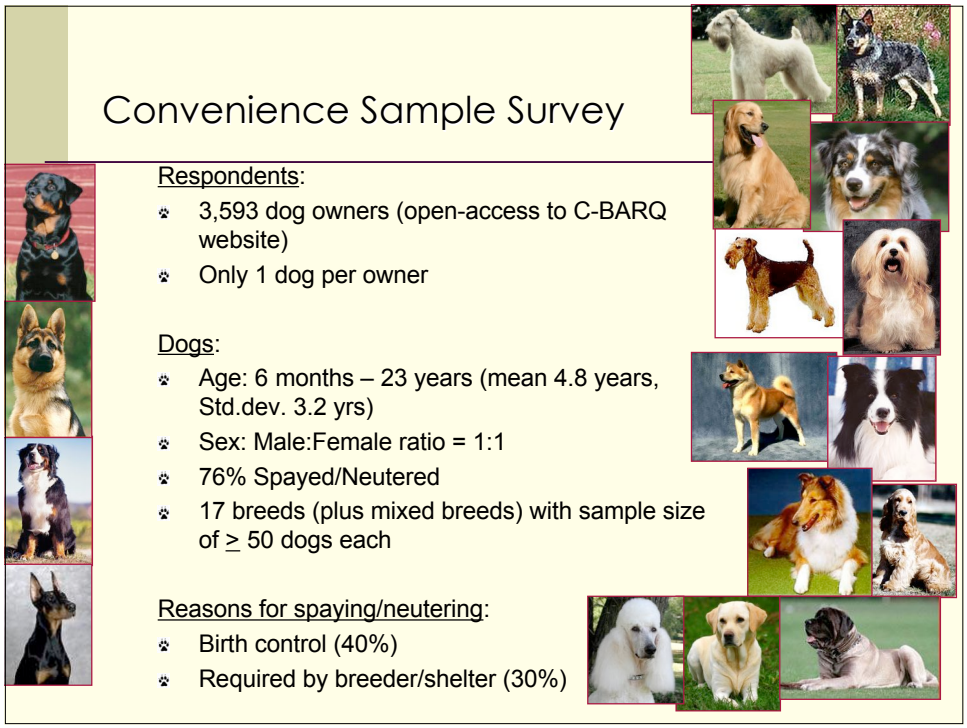

SPAYED FEMALES ARE MORE AGGRESSIVE TOWARD PEOPLE
Stranger-directed aggression
Owner-directed aggression
**
*
n=345
n=164
n=377
n=174
INTACT
SPAYED
INTACT
SPAYED
** p < 0.025
* p = 0.06
Mann-Whitney U test

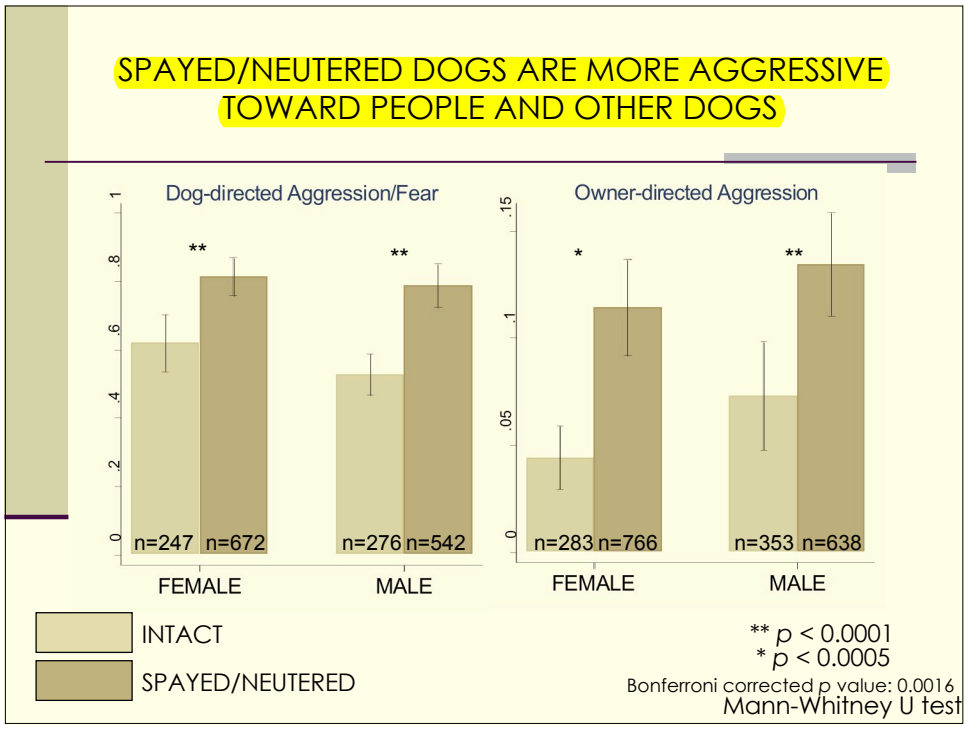

SPAYED FEMALES ARE MORE FEARFUL AND SENSITIVE TO TOUCH
Non-social fear
Touch sensitivity
*
**
n=349
n=166
n=393
n=181
INTACT
SPAYED
INTACT
SPAYED
* p < 0.05
** p < 0.025
Mann-Whitney U test

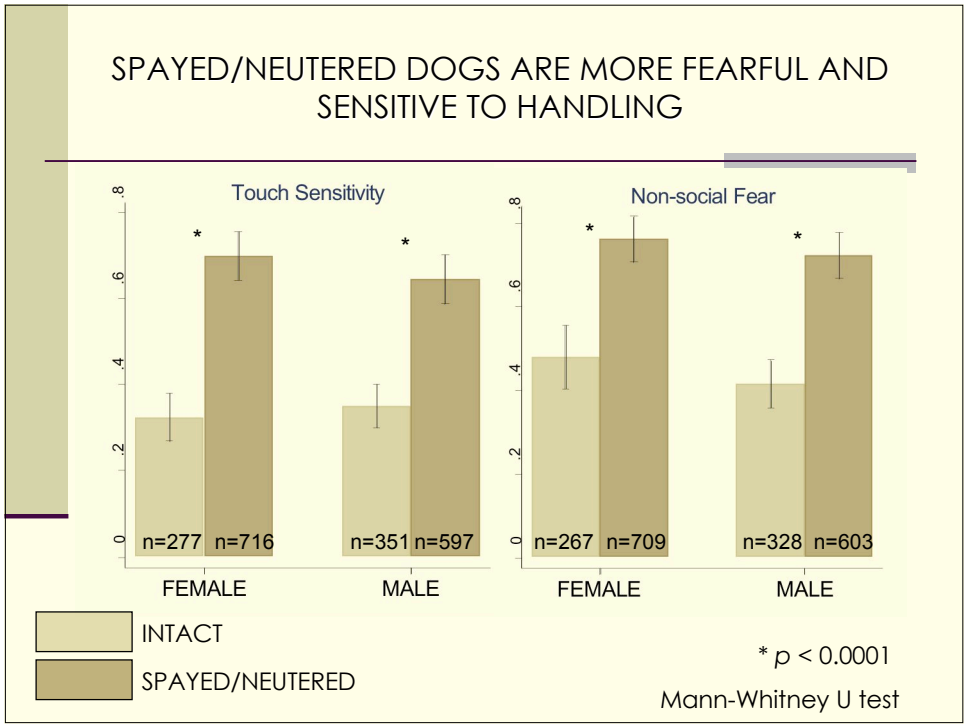

NEUTERED MALES MARK THEIR
"TERRITORIES" LESS OFTEN
Urine marking
MALES
0
.2
.4
.6
*
n = 502
n = 80
INTACT
NEUTERED
* p < 0.005
Mann-Whitney U test

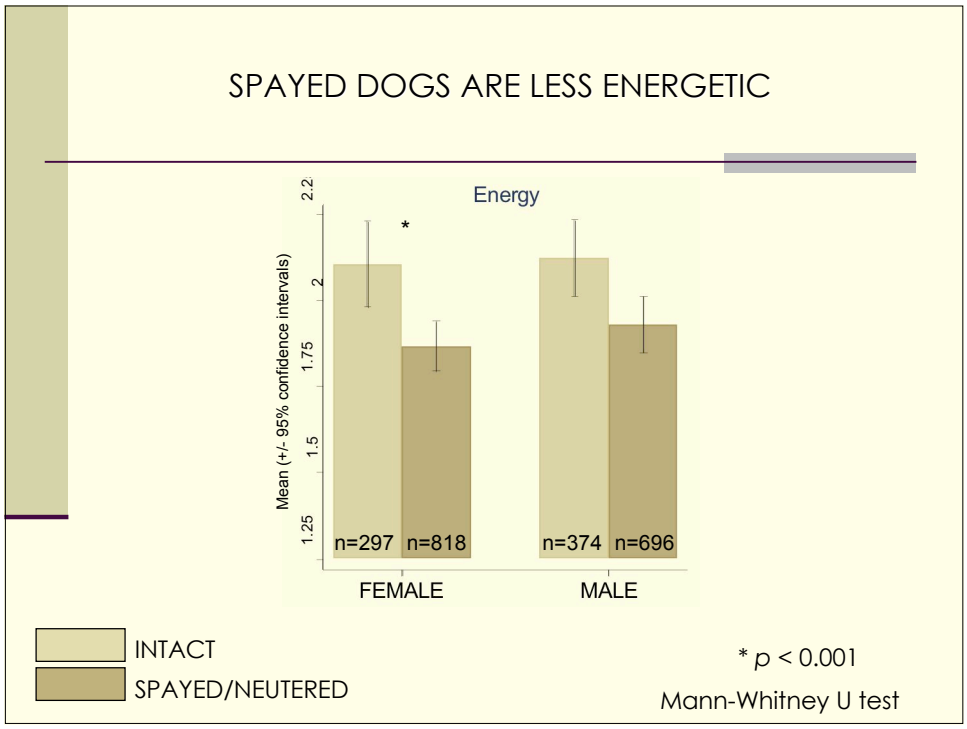

SPAYED/NEUTERED DOGS BEG FOR FOOD
AND LICK PEOPLE/OBJECTS MORE OFTEN
Begs for food
Excessive licking of people/objects
0
.5
1
1.5
2
0
.2
.4
.6
.8
1
**
**
*
*
n=398 n=188
n=502 n=79
n=406 n=189
n=520 n=80
FEMALE
MALE
FEMALE
MALE
INTACT
SPAYED/NEUTERED
** p < 0.001
* p < 0.004
Mann-Whitney U test

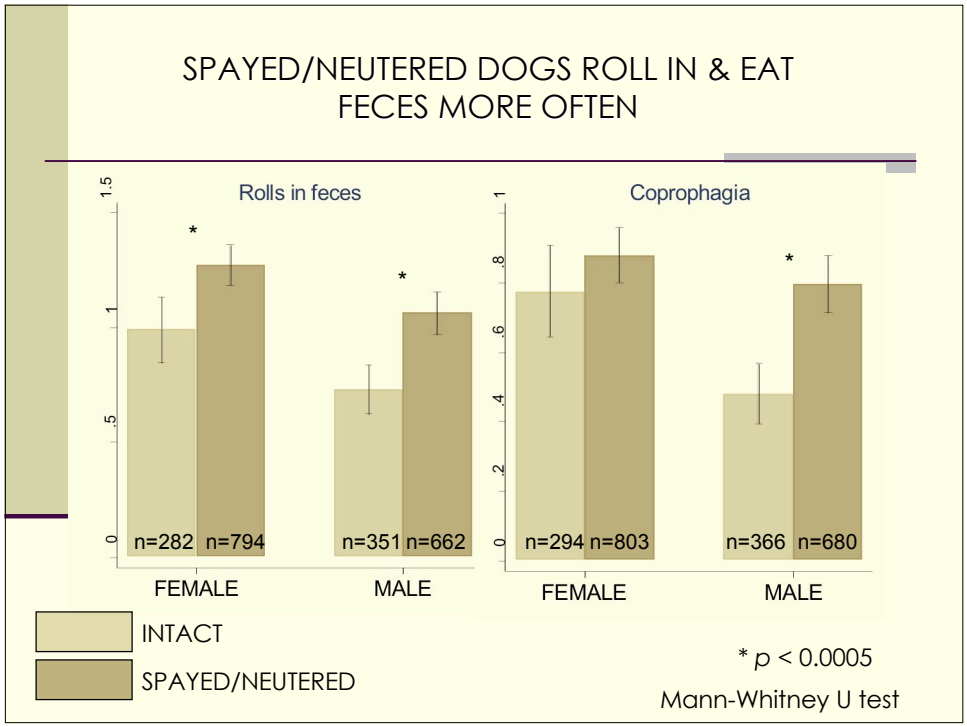

BREED-SPECIFIC EFFECTS OF SPAYING/NEUTERING
DOG-DIRECTED AGGRESSION/FEAR
***
*
**
,5
1
English Springer Spaniel
Dachshund
Golden Retriever
Labrador
Poodle
Shetland Sheepdog
Rottweiler
Siberian Husky
West Highland Terrier
Yorkshire Terrier
INTACT
SPAYED/NEUTERED
*** p < 0.005 (dog-directed aggression/fear)
* p < 0.05 (dog-directed fear)
** p < 0.05 (dog-directed aggression)

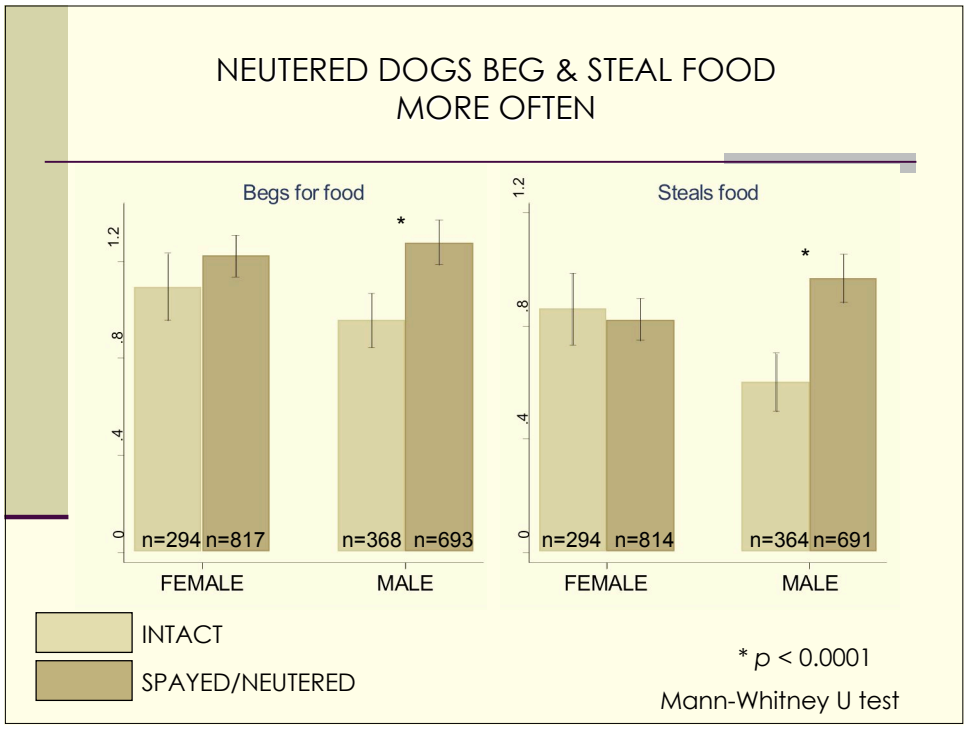

Convenience Sample Survey
Respondents:
3,593 dog owners (open-access to C-BARQ website)
Only 1 dog per owner
Dogs:
Age: 6 months – 23 years (mean 4.8 years, Std.dev. 3.2 yrs)
Sex: Male:Female ratio = 1:1
76% Spayed/Neutered
17 breeds (plus mixed breeds) with sample size of ≥ 50 dogs each
Reasons for spaying/neutering:
Birth control (40%)
Required by breeder/shelter (30%)

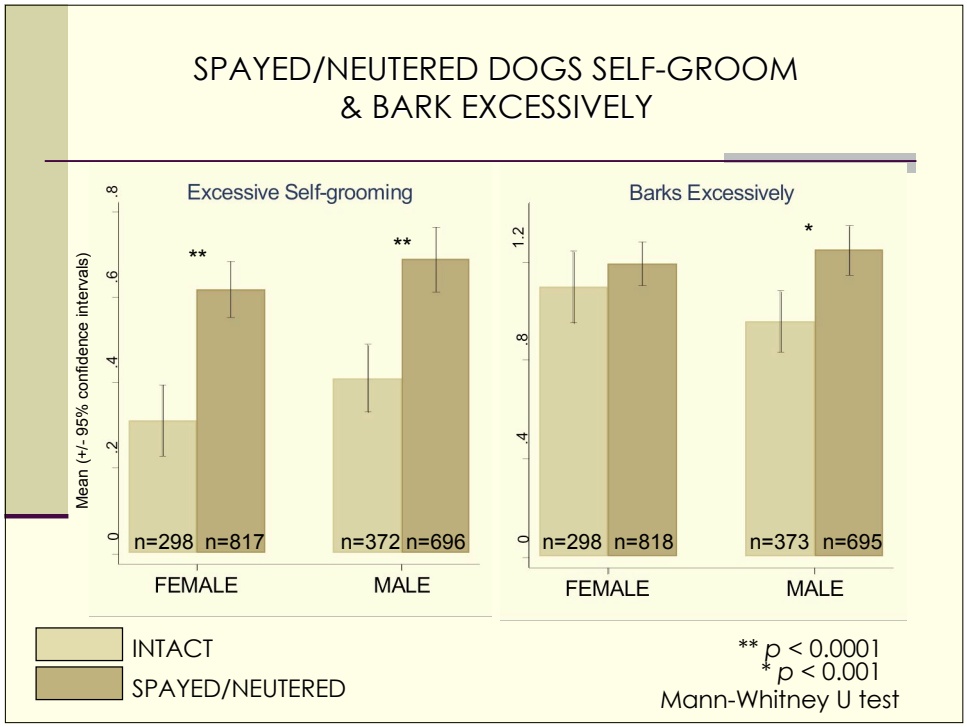

SPAYED/NEUTERED DOGS ARE MORE AGGRESSIVE TOWARD PEOPLE AND OTHER DOGS
Dog-directed Aggression/Fear
Owner-directed Aggression
n=247 n=672
n=276 n=542
n=283 n=766
n=353 n=638
FEMALE
MALE
INTACT
SPAYED/NEUTERED
** p < 0.0001
* p < 0.0005
Bonferroni corrected p value: 0.0016
Mann-Whitney U test

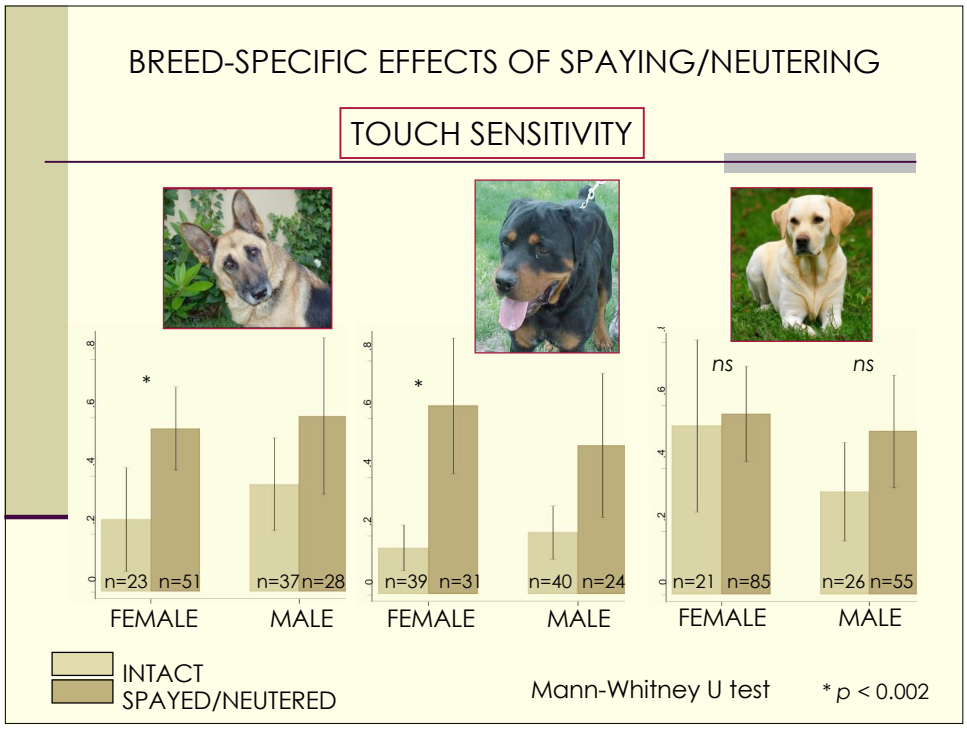

SPAYED/NEUTERED DOGS ARE MORE FEARFUL AND SENSITIVE TO HANDLING
Touch Sensitivity
Non-social Fear
n=277 n=716
n=351 n=597
n=267 n=709
n=328 n=603
FEMALE
MALE
INTACT
SPAYED/NEUTERED
* p < 0.0001
Mann-Whitney U test

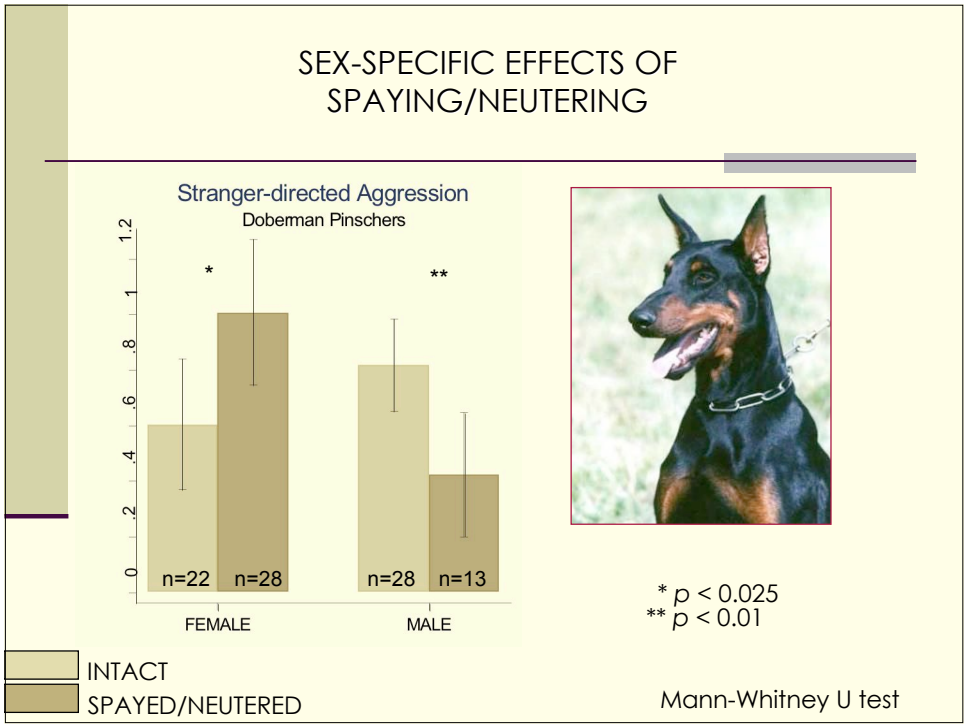

SPAYED DOGS ARE LESS ENERGETIC
Energy
Mean (+/- 95% confidence intervals)
2.2
2
1.75
1.5
1.25
*
n=297
n=818
n=374
n=696
FEMALE
MALE
INTACT
SPAYED/NEUTERED
* p < 0.001
Mann-Whitney U test


SPAYED/NEUTERED DOGS ROLL IN & EAT FECES MORE OFTEN
Rolls in feces
Coprophagia
1.5
1
.5
0
.8
.6
.4
.2
*
n=282
n=794
n=351
n=662
n=294
n=803
n=366
n=680
FEMALE
MALE
INTACT
SPAYED/NEUTERED
* p < 0.0005
Mann-Whitney U test


NEUTERED DOGS BEG & STEAL FOOD MORE OFTEN
Begs for food
Steals food
Mean (+/- 95% confidence intervals)
0
.4
.8
1.2
*
n=294 n=817
n=368 n=693
n=294 n=814
n=364 n=691
FEMALE
MALE
INTACT
SPAYED/NEUTERED
* p < 0.0001
Mann-Whitney U test


SPAYED/NEUTERED DOGS SELF-GROOM & BARK EXCESSIVELY
Excessive Self-grooming
Barks Excessively
Mean (+/- 95% confidence intervals)
0
.2
.4
.6
.8
1.2
**
*
n=298 n=817
n=372 n=696
n=298 n=818
n=373 n=695
FEMALE
MALE
INTACT
SPAYED/NEUTERED
** p < 0.0001
* p < 0.001
Mann-Whitney U test


BREED-SPECIFIC EFFECTS OF SPAYING/NEUTERING
TOUCH SENSITIVITY
*
*
ns
ns
n=23 n=51
n=37 n=28
n=39 n=31
n=40 n=24
n=21 n=85
n=26 n=55
FEMALE
MALE
FEMALE
MALE
FEMALE
MALE
INTACT
SPAYED/NEUTERED
Mann-Whitney U test
* p < 0.002


SEX-SPECIFIC EFFECTS OF
SPAYING/NEUTERING
Stranger-directed Aggression
Doberman Pinschers
*
**
n=22 n=28
n=28 n=13
FEMALE
MALE
* p < 0.025
** p < 0.01
INTACT
SPAYED/NEUTERED
Mann-Whitney U test

SUMMARY

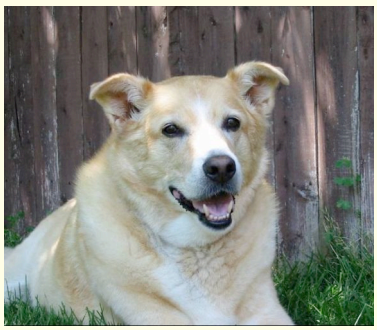
- For most behaviors, spaying/neutering was associated with worse behavior, contrary to conventional wisdom.
- A few behaviors (e.g., energy level, urine marking) were reduced in spayed/neutered dogs.
- The effects of spaying/neutering are often specific to certain breeds and are not always equivalent between sexes.

CONCLUSIONS

- Significant differences in scores do not necessarily indicate severe behavioral problems.
- Neutering male dogs does not render them useless for protection or guarding.
- We need to investigate mechanisms for behavioral effects of spaying and develop alternatives.
- Dog owners need to receive accurate information to help them form realistic expectations.

ACKNOWLEDGEMENTS

- Dr. Yuying Hsu (Nat. Taiwan Normal University).
- Kathy Kruger (Univ. of Pennsylvania).
- The Arell Foundation, The Kenneth A. Scott Charitable Trust, The Pet Care Trust, The University of Pennsylvania Research Foundation, AKC Canine Health Foundation, and the Arthur L. "Bud" Johnson Foundation.
- Various breed clubs.
- All participants.



ELSEVIER

Applied Animal Behaviour Science 47 (1996) 75–89

APPLIED ANIMAL BEHAVIOUR SCIENCE

The English Cocker Spaniel: preliminary findings on aggressive behaviour

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Abstract

Two thousand questionnaires were distributed randomly via the Kennel Club (UK) to owners of purebred English Cocker Spaniels (ECSs). Owners were asked to give details about the ECSs they owned: age, sex, neuter status, coat colour. They were also asked to indicate whether their dog showed aggression (on a 1–5 scale; 1, never or almost never; 5, always or almost always) in any of 13 situations. These were: aggression towards strange dogs (A1), towards strangers approaching the dog (A2), towards persons approaching/visiting the home (A3), towards persons approaching the owner away from home (A4), towards children in the household (A5), towards other dogs in the household (A6), when the owner gives attention to other person or animal (A7), toward owner or member of owner's family (A8), when disciplined (A9), when reached for or handled (A10), when in restricted spaces (A11), at meal times/ defending food (A12) and, suddenly and without apparent reason (A13).

A total of 1008 (50.4%) replies was received, of which 932 (owning 1109 dogs) were suitable for analysis. Solid colour ECSs were significantly more likely to show aggression than parti-colours in 12 out of the 13 situations (A2–A13) and red/goldens were more likely to show aggression than blacks in situations A1, A4, A5 and A7–A13 inclusive. Males were significantly more likely to show aggression than females in situations A1, A8, A9 and A10 while females were significantly more likely to show aggression towards other dogs in the household (A6). When comparing ECSs which had been neutered before signs of aggression were apparent, with entires, neutered females were found more likely to show aggression towards children in the household (A5). Cluster analysis revealed six groups of associated variables; these were labelled, 'protective (of itself and owner)', 'protective (of territory)', 'intraspecific (unfamiliar dogs)', 'competitive', 'possessive', and 'dominance-type' aggression. Most dogs showed 'protective (of territory)' aggression (45.7%) while 'dominance-type' aggression was the least common (11.7%).

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The results suggest a genetic and neuroendocrine basis for the within-breed differences in aggression. Neutering was not found to be useful as a preventative measure for aggression. From the cluster analysis, there was some evidence that so-called 'rage' syndrome, a condition often reported in the breed and one which is characterised by sudden and unpredictable aggression, is an expression of social dominance, rather than being a separate or pathological phenomenon. Follow-up projects are now underway and it is hoped they will lead to a better understanding of all types of canine aggression, and provide an answer as to whether or not 'rage' truly exists as a distinct phenomenon.

1. Introduction

Although the English Cocker Spaniel (ECS) is a popular breed in the United Kingdom, it has attracted some negative publicity, especially during the early 1980s because of problems with aggressive behaviour. Mugford (1984) reported that the ECS was the third most common breed seen at his behavioural referral practice in Britain and that most (74%) cases of aggression involved those of the red/golden coat colour type. In particular, the breed has become synonymous with a condition called 'rage' syndrome, where a dog suddenly and inexplicably is aggressive towards its owners or other household members. This type of aggression has also been reported in other breeds such as American Cocker Spaniels (Dodman et al., 1992), Bernese Mountain Dogs (Van der Velden et al., 1976), Chesapeake Bay Retrievers (Dodman et al., 1992), Dobermanns (Hart and Hart, 1985), English Bull Terriers (Neville, 1991), English Springer Spaniels (Dodman et al., 1992), German Shepherds (Hart and Hart, 1985), Golden Retrievers (Fisher, 1993), Pyrenean Mountain Dogs (Neville, 1991) and St. Bernards (Hart and Hart, 1985). However, it is a rare condition (Hart and Hart, 1985; Blackshaw, 1987; Blackshaw, 1991; Reisner, 1991) and there are no published data on its prevalence in ECSs.

There are two main theories as to what this syndrome could be. First, that it is an exaggerated or unusual form of dominance aggression (Mugford, 1984; Neville, 1991; Reisner, 1991; O'Farrell, 1992). Secondly, that it is a type of epilepsy, part of a group known as complex partial seizures (Colter, 1989). It closely resembles a form of subthreshold limbic epilepsy known as episodic dyscontrol syndrome (Dodman et al., 1992) a condition for which there is some electroencephalographic evidence. Beaver (1980) reported on a condition she labelled 'mental lapse' syndrome which is similar to 'rage' syndrome and episodic dyscontrol syndrome. However, there have been no further reports of it in the literature. To date, macroscopic and microscopic investigations of the brains of dogs euthanised because of unexplained, severe aggression have revealed only a mild degree of encephalitis in some cases (Hart, 1977). Mugford (1984) argued that there may be a genetic basis for 'rage' syndrome in ECSs and Van der Velden et al. (1976) has shown evidence for this in Bernese Mountain Dogs.

To learn more about aggression in the ECS and to determine whether 'rage ' exists and if so, where it fits in the classification of canine aggression, a multi-layered study has been initiated at the University of Cambridge Veterinary School. This paper reports on the first stage of the programme which involved a large scale survey of owners of purebred ECSs.

2. Animals, materials and methods

Two thousand one-page (double-sided) questionnaires were distributed randomly through the postal system in November 1992 via the Kennel Club (UK) to UK owners of purebred ECSs. Professional breeders, however, were excluded from the study as it was thought unlikely that they would report truthfully on aggressive behaviour in their dogs. The replies were sent to the principal author using a FREEPOST address. Owners were asked to provide their name, address and phone number and to indicate how many adults and children (under 16 years of age) lived in the household. They were also asked about the number of ECSs they owned and for a description of each: name of dog, coat colour, age, sex, and whether or not it had been neutered. Finally, they were asked to consider whether their dog (a separate sheet was available for each dog) showed aggression in any of 13 situations (see Table 1). The owners indicated the relative frequency of such behaviour on a 1–5 scale for each of the 13 situations: 1, never or almost never; 2, rarely; 3, occasionally; 4, usually; 5, always or almost always.

All data were analysed using the statistical package SPSS for the Macintosh: Version 4.0. The Mann–Whitney U test (see Siegel and Castellan, 1988) was used to compare solids with particolours, red/goldens with blacks, males with females, neutered males with entire males, and neutered females with entire females in each of the 13 (A1–A13) situations in which aggression could occur (see Table 2 for N values). Agglomerative hierarchical cluster analysis, using Ward's method and squared Euclidean distances (see Hair et al., 1987), was performed on these 13 variables to determine clusters or groups of related situations. From these it was possible to label the clusters into 'types' of aggression.

In order to calculate the percentage of dogs aggressive in each of the 13 situations, the rating scale was reduced to a 'present' or 'absent' scoring system (1–2, 'absent'; 3–5, 'present'). The mean of the percentages related to each aggression group or cluster was then calculated to show the incidence of these in the ECS population.

Table 1
The 13 different situations about which the owners were asked to rate the relative frequency of their dog's likelihood to show aggression

Aggressive situation	Code
Towards strange dogs	A1
Towards strangers approaching the dog	A2
Towards persons approaching/visiting the home	A3
Towards persons approaching owner away from home	A4
Towards children in the household	A5
Towards other dogs in the household	A6
When owner gives attention to other person or animal	A7
Toward owner or member of owner's family	A8
When disciplined	A9
When reached for or handled	A10
When in restricted spaces	A11
At meal times/defending food	A12
Sudden and without apparent reason	A13

3. Results

A total of 1008 (50.4%) replies was received, of which 932 (owning 1109 dogs) were suitable for analysis. A good representation of registered ECSs was achieved as the distribution of coat colours of the survey dogs compared well with the coat colours of ECSs registered in 1992 in the UK.

Registration figures for the breed, including coat colour of the dogs, were obtained from the Kennel Club (UK) for the period 1982–1992. This was done to see if the negative publicity of the early 1980s had had an effect on preferences for the breed and for coat colour. Although the percentage of ECSs registered fell from 1982 to 1987, they then rose and continued to do so through to 1992 (Fig. 1). However, coat colour preferences showed a more sustained change. The popularity of solid colours decreased from a time when they were the most popular colour type, 1982; particolours have been more popular ever since (Fig. 2). This change in solid colour preference is due to a decrease in the number of red/goldens being registered (Fig. 3).

3.1. Demographics

The mean number of adults in the households was 2.3 (range 1–10, mode 2) and the mean number of children was 0.7 (range 0–5); only 40% of owners had children.

The mean number of ECSs owned was 1.2: 86% owned one, 11% owned two and 3% owned three or more. The mean age of these dogs was 2.7 years (range 0.25–17 years, mode 2.5 years). Solid colour dogs made up 38.6% of the sample and particolours 61.4%. Of the solid colours, 47.9% were blacks while 52.1% were red/goldens. There were similar numbers of males (545, 49.1%) and females (564, 50.9%) in the sample and most were entires (66.8% females, 82.7% males).

Table 2
N values for the various Mann–Whitney *U* tests which were performed

Variable	Aggressive situation												
	A1	A2	A3	A4	A5 [a]	A6 [a]	A7	A8	A9	A10	A11	A12	A13
Solid colour	426	428	428	426	142	373	425	428	427	428	423	426	428
Particolour	679	679	680	679	272	622	678	677	680	680	677	678	680
Red/golden	221	223	223	222	78	192	222	223	222	223	220	222	223
Black	205	205	205	204	64	181	203	205	205	205	203	204	205
Male	544	544	545	543	199	478	543	545	545	545	541	542	545
Female	562	564	564	563	215	518	561	561	563	564	560	563	564
Neutered male	94	93	94	94	33	76	93	94	94	94	94	94	94
Entire male	447	448	448	446	165	399	447	448	448	448	444	445	448
Neutered female	183	184	184	183	53	160	182	184	183	184	182	183	184
Entire female	370	371	371	371	158	349	370	368	371	371	369	371	371

[a] *N* values are smaller than for the other aggressive situations because not every owner could respond to these, i.e. because not every owner had other dogs in the house and because most (60%) did not have children.

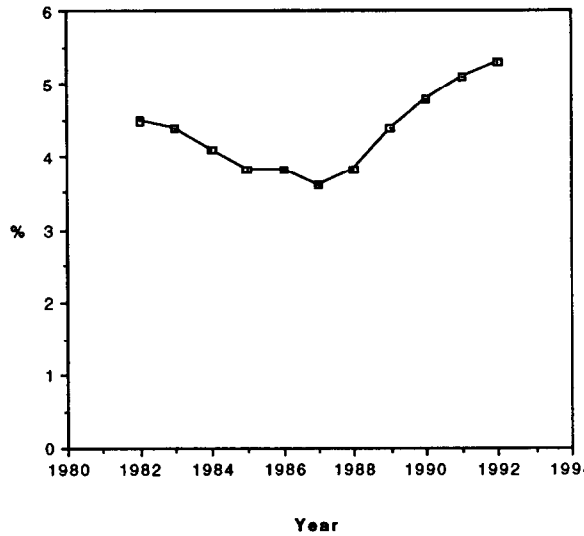

Fig. 1. The percentage of the total number of dog registrations with the Kennel Club (UK) which were English Cocker Spaniels (1982–1992).

3.2. Solid vs. particolour English Cocker Spaniels

Solid colours were significantly more likely to show signs of aggression than particolours in 12 out of the 13 situations. These included A2 (towards strangers

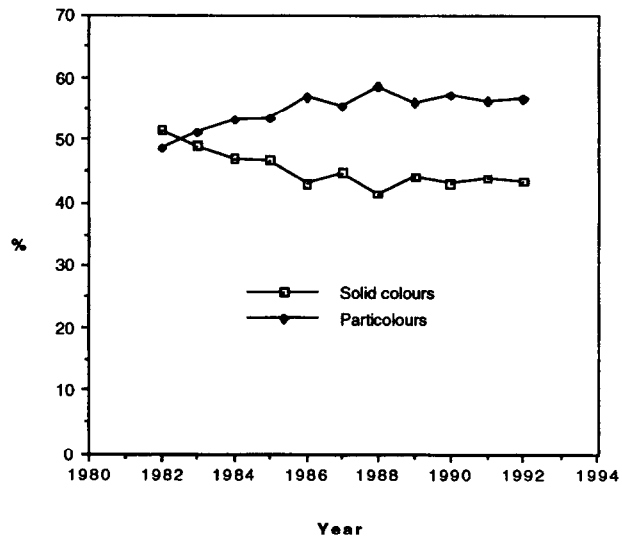

Fig. 2. The percentage of English Cocker Spaniels registered with the Kennel Club (UK) which were either solid colour or particolour (1982–1992).

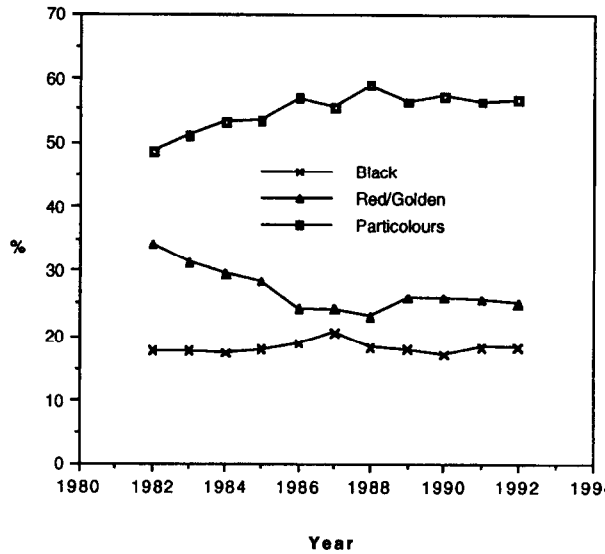

Fig. 3. The percentage of English Cocker Spaniels registered with the Kennel Club (UK) which were either red/golden, black or particolour (1982–1992).

approaching the dog; Mann–Whitney U test, $Z = 3.723$, $P < 0.001$), A3 (towards persons approaching/visiting the home; $Z = 4.213$, $P < 0.001$), A4 (towards persons approaching owner away from the home; $Z = 4.514$, $P < 0.001$), A5 (towards children in the household; $Z = 6.462$, $P < 0.001$), A6 (towards other dogs in the household; $Z = 2.163$, $P < 0.05$), A7 (when owner gives attention to other person or animal; $Z = 4.452$, $P < 0.001$), A8 (toward owner or member of owner's family; $Z = 9.766$, $P < 0.001$), A9 (when disciplined; $Z = 8.623$, $P < 0.001$), A10 (when reached for or handled; $Z = 7.255$, $P < 0.001$), A11 (when in restricted spaces; $Z = 7.631$, $P < 0.001$), A12 (at meal times/defending food; $Z = 9.547$, $P < 0.001$), and A13 (sudden and without apparent reason; $Z = 8.057$, $P < 0.001$).

3.3. Red/goldens vs. black English Cocker Spaniels

Within the solid colour group, red/goldens were compared with blacks. Here it was found that red/goldens were significantly more likely to be aggressive in a number of situations. These included, A1 (towards strange dogs; Mann–Whitney U test, $Z = 2.582$, $P < 0.01$), A4 (towards persons approaching owner away from home; $Z = 2.774$, $P < 0.01$), A5 (towards children in the household; $Z = 3.365$, $P < 0.001$), A7 (when owner gives attention to other person or animal; $Z = 3.336$, $P < 0.001$), A8 (toward owner or member of owner's family; $Z = 4.988$, $P < 0.001$), A9 (when disciplined; $Z = 4.524$, $P < 0.001$), A10 (when reached for or handled; $Z = 3.161$, $P < 0.01$), A11 (when in restricted spaces; $Z = 2.4$, $P < 0.05$), A12 (at meal times/ defending food; $Z = 3.492$, $P < 0.001$), A13 (sudden and without apparent reason; $Z = 3.643$, $P < 0.001$).

3.4. Males vs. females

Males were more likely to be aggressive than females in situations A1 (towards strange dogs; Mann–Whitney U test, $Z = 2.02$, $P < 0.05$), A8 (toward owner or member of owner's family; $Z = 2.089$, $P < 0.05$), A9 (when disciplined; $Z = 4.459$, $P < 0.001$) and A10 (when reached for or handled; $Z = 2.235$, $P < 0.05$). Females were more likely to be aggressive than males in situation A6 (aggression towards other dogs in the household; $Z = 2.763$, $P < 0.01$) only.

3.5. Neutered males vs. entire males

Neutered males were found to be significantly more aggressive than entire males in situations A5 (towards children in the household; Mann–Whitney U test, $Z = 3.967$, $P < 0.001$), A8 (toward owner or member of owner's family; $Z = 4.066$, $P < 0.001$), A9 (when disciplined; $Z = 4.032$, $P < 0.001$), A10 (when reached for or handled; $Z = 4.28$, $P < 0.001$), A11 (when in restricted spaces; $Z = 2.917$, $P < 0.01$), A12 (at meal times/defending food; $Z = 2.724$, $P < 0.01$), and A13 (sudden and without apparent reason; $Z = 4.736$, $P < 0.001$).

3.6. Neutered females vs. entire females

Neutered females were found to be significantly more likely to be aggressive than entire females in situations A2 (towards strangers approaching the dog; Mann–Whitney U test, $Z = 1.963$, $P < 0.05$), A3 (towards persons approaching/visiting the home; $Z = 2.494$, $P < 0.05$), A4 (towards persons approaching owner away from home; $Z = 2.74$, $P < 0.01$), A5 (towards children in the household; $Z = 3.246$, $P < 0.01$), A8 (toward owner or member of owner's family; $Z = 3.289$, $P < 0.01$), A9 (when disciplined; $Z = 4.127$, $P < 0.001$), A10 (when reached for or handled; $Z = 2.805$, $P < 0.01$), A11 (when in restricted spaces; $Z = 2.211$, $P < 0.05$), A12 (at meal times/defending food; $Z = 2.465$, $P < 0.05$), and A13 (sudden and without apparent reason; $Z = 2.458$, $P < 0.05$).

3.7. Follow-up study

As the neutering results were surprising it was decided to further investigate the effects of neutering by contacting the owners of all neutered ECSs and asking for details on (1) age at which aggression started (if dog was aggressive at all), (2) age at which the dog was neutered and (3) why the dog was neutered. Data were collected on 149 (81%) neutered females and 73 (78%) neutered males. The mean age at which aggression started was 0.9 years (11 months) for males and females, while the mode was 0.5 years (6 months) and 0.2 years (2 months), respectively. Neutered dogs were once again compared with entires using the Mann–Whitney U test for each of the 13 situations in which aggression could occur. However, this time dogs which were neutered because they were aggressive and those which were neutered after aggressive behaviour had first started, were excluded (neutered males $N = 55$, neutered females $N = 139$). This would

Table 3
The components of each cluster and the labels assigned

Cluster label	Components
Protective (of itself and owner)	Aggression towards: strangers approaching the dog (A2) persons approaching owner away from home (A4)
Protective (of territory)	Aggression towards persons approaching/visiting the home (A3)
Intraspecific (unfamiliar dogs)	Aggression towards strange dogs (A1)
Competitive	Aggression: towards other dogs in the household (A6) when owner gives attention to other person or animal (A7)
Possessive	Aggression at meal times/defending food (A12)
Dominance-type	Aggression: toward owner or member of owner's family (A8) when disciplined (A9) when reached for or handled (A10) when in restricted spaces (A11) sudden and without apparent reason (A13)

then tell us if neutering was in some way a precursor to aggression. The results of this analysis revealed that neutering was probably the consequence of aggressiveness rather than the cause. All statistically significant differences between neutered and entire males disappeared when dogs which had been neutered either after or because they became aggressive were removed from the sample. The same was largely true for females,

Table 4
Mean percentage of English Cocker Spaniels showing a particular category of aggression

Aggression category	Components	*N* (aggression present)	Total *N*	%	Mean % for category
Protective (of itself and owner)	A2	198	1108	17.9	15.2
	A4	138	1106	12.5	
Protective (territory)	A3	507	1109	45.7	45.7
Intraspecific (unfamiliar dogs)	A1	317	1106	28.7	28.7
Competitive	A6	184	996	18.5	17.8
	A7	190	1104	17.2	
Possessive	A12	266	1105	24.1	24.1
Dominance-type	A5	44	414	10.6	11.7
	A8	124	1106	11.2	
	A9	184	1108	16.6	
	A10	124	1109	11.2	
	A11	126	1101	11.4	
	A13	91	1109	8.2	

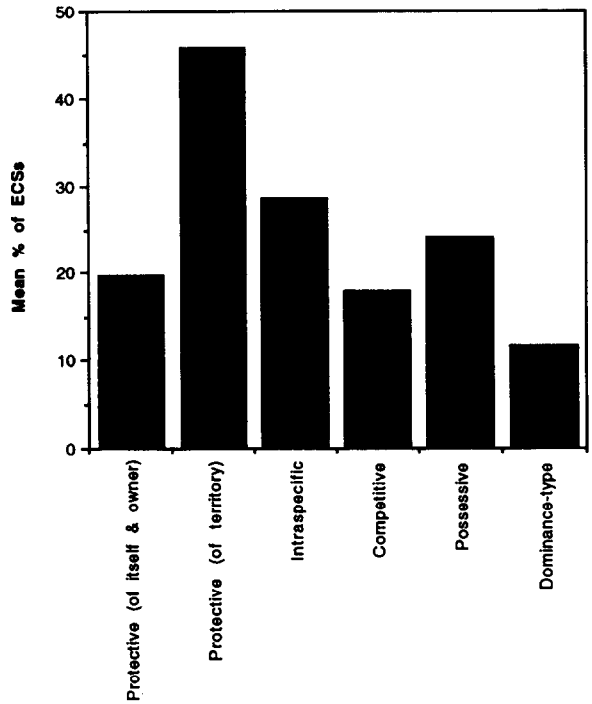

Fig. 4. The mean percentage of English Cocker Spaniels showing any of the six types of aggression determined by the cluster analysis.

except that neutered females were now found to be significantly more likely to display aggression towards children in the household (Mann–Whitney U test, $Z = 2.015$, $P < 0.05$).

3.8. Cluster analysis

Changes in agglomeration coefficients between cluster stages were used to determine the number of significant clusters; a six cluster solution was achieved. This solution was cross-validated using the technique of split sample replication (see Hair et al., 1987 for details). The six groups or clusters were labelled ' protective (of itself and owner)', 'protective (of territory)', 'intraspecific (unfamiliar dogs)', 'competitive', ' possessive', and ' dominance-type' aggression (see Table 3).

The percentage of dogs which were aggressive (scored 3, 4 or 5 on the rating scale) in any of the 13 situation variables and the mean percentage which displayed a particular type or category of aggression are provided in Table 4. Most ECSs (45.7%) showed protective (of territory) aggression while dominance-type aggression was least common (11.7%; Fig. 4).

4. Discussion

The interpretation of the results of this study rests heavily on the reliability and validity of the methods used to measure aggressive behaviour. When completed by persons familiar with the animals being assessed, subjective rating scales of the type employed here have been found to provide reliable measures of individual differences in behaviour in laboratory rhesus monkeys (Stevenson-Hinde et al., 1980; Stevenson-Hinde, 1983) and domestic cats (Feaver et al., 1986). However, although comparable techniques have also been used to elicit owner assessments of both dog (Serpell, 1983; Serpell and Jagoe, 1995) and cat (Turner and Stammbach-Geering, 1990) behaviour, their accuracy and reliability have not been tested. This raises the possibility that any observed differences between different subgroups within the same population of ECSs are simply artefacts of biases in owners' perceptions. For example, it is possible (though unlikely) that the owners of solid colour ECSs tend to perceive them as being more aggressive than do the owners of particolour dogs, regardless of any actual differences in behaviour. The use of quantitative rather than qualitative rating scales would be expected to reduce the likelihood of these kinds of subjective biases.

It should also be emphasised that, while the present findings are statistically highly significant in many cases, the overall effect sizes are relatively small. In other words, a finding that is probably true for the sampled population as a whole, for example, solid colour ECSs are more aggressive than particolours, is unlikely to be reliable at the level of the individual dog.

Coinciding with the negative publicity about the breed during the early 1980s, the percentage registered with the Kennel Club (UK) dropped but then rose again in the latter part of that decade. However, a more decided change occurred with coat colour preference. The decrease in popularity of the solid colours, especially the red/goldens, suggests that the negative publicity had a sustained effect. The ability of the print media to affect human attitudes and preferences to particular breeds of dog has been discussed previously by Podberscek (1994).

The existence of significant behavioural differences between the different colour morphs of the breed is interesting in the light of the view of Hemmer (1990) that coat colour in domestic animals is often closely associated with temperament (the hypothesis is based on the fact that the pigment melanin shares a common biochemical synthesis pathway with the catecholamine group of neurotransmitters). The fact that solid colour animals were more aggressive than particolours in 12 out of the 13 different contexts certainly suggests a genetic basis for this difference. It does not, however, provide support for Hemmer's theory since the bloodlines of these two colour variants are known to be quite distinct (Lloyd Carey, 1992). In addition, within the solid colour group, the red/golden variety was more aggressive, on average, than the black, and this agrees with the findings of Mugford (1984) who also noted that the red/golden variant appeared to be more inbred. Current follow-up research on the pedigrees of a subset of aggressive and non-aggressive dogs should help to clarify this issue.

A further interesting theoretical issue raised by the present findings concerns the apparent evidence for 'global' genetic effects on aggressiveness. According to the conventional view, different forms of aggressive behaviour, such as territorial or

dominance-related aggression, are differently motivated and therefore likely to be under the influence of separate genetic and physiological controls (see Serpell and Jagoe, 1995). Indeed, the ways in which the different behaviour patterns grouped in the cluster analysis is broadly consistent with this idea. The differences in aggressiveness between solid and particolour ECSs were, however, virtually consistent across all the different aggressive contexts, and this would suggest some underlying causal link. It is possible that solid colour forms (especially red/goldens) are simply more 'reactive' to stimuli (sensu Hart and Hart, 1985) than particolours in a general way. Unfortunately, the reactivity of the dogs in other, non-aggressive contexts was not measured in the present study. In any case, the possible genetic and neuroendocrine basis for these apparent within-breed differences in overall aggressiveness would probably repay more detailed investigation.

Although there are many examples in the literature suggesting that male dogs are more likely to be aggressive than females (see Borchelt, 1983; Mugford, 1984; Wright and Nesselrote, 1987; Podberscek and Blackshaw, 1990; Blackshaw, 1991; Landsberg, 1991; Wright, 1991; Beaver, 1993; Podberscek and Blackshaw, 1993) this was only supported in four out of the 13 situations recorded, and females were more aggressive than males in one situation (aggression towards other dogs in the household). One of the reasons for this difference could be that some researchers have not looked for sex differences in the different types of aggression, rather they have lumped all types together. Also, and more importantly, most studies do not have a control group of randomly selected dogs and therefore it is not possible to say whether either sex is actually overrepresented. To support the present findings, Scott and Fuller (1965, p. 419) found reduced sex differences in aggressiveness in relatively non-aggressive breeds, such as the (American) Cocker Spaniel, compared with aggressive breeds such as Fox Terriers and Basenjis, particularly with respect to social dominance. Males in the present study were more likely to be aggressive towards strange dogs and this also was the only component of the 'intraspecific (unfamiliar dogs)' cluster. Most cases of this sort of aggression have been attributed to males and usually involve male to male fighting and may be affected by circulating androgens (Borchelt, 1983; Hart and Hart, 1985; O'Farrell, 1992).

Females were more likely to be aggressive towards other dogs in the household and this may be because these households owned other female dogs; females rarely fight with males (see Borchelt, 1983). Unfortunately, the composition of the households in terms of the number and sex of other dogs was unknown.

Male dogs neutered before signs of aggression had appeared were not different from entire males in their likelihood of showing aggression in any of the 13 situations. This implies that neutering was not effective in preventing aggression and agrees with the findings of Le Boeuf (1970) and Salmeri et al. (1991). Other research, however, has indicated that neutered dogs are less aggressive than entires (Beaver, 1983; Borchelt, 1983; Wright and Nesselrote, 1987; Blackshaw, 1991). These previous studies, however, are based on cases presented to behavioural clinics without data on the age at which neutering took place being collected or at least this was not taken into account in the analyses. Hopkins et al. (1976) found that intermale fighting decreased when adult dogs were castrated but that territorial and fear-induced aggression were not.

Compared to entire bitches, female ECSs which were neutered before they showed any signs of aggression were only more likely to show aggression towards children in the household. There are a number of studies which have indicated that neutered females are more likely to be aggressive than entires (Borchelt, 1983; Wright and Nesselrote, 1987; O'Farrell and Peachey, 1990). However, Blackshaw (1991) in her study of 87 cases of canine aggression, found that neutered females were the smallest group. Only O'Farrell and Peachey (1990) have conducted a systematic and scientific study on the effects of neutering in bitches. Their study of 150 bitches whose behaviour was assessed before and after neutering and compared with a control group of 150 entires showed that dominance aggression increased significantly after neutering compared with controls. This increase was most likely to be shown in puppies under one year of age which were already showing signs of aggression. A difference in the present study is that dogs aggressive before neutering are not included in the analyses thus indicating that neutering is not a preventative measure for aggression in bitches and should be avoided especially if there are children in the household.

The mean age at which aggression started for both the neutered males and females in the follow-up study was 11 months while Mugford (1984) reported a mean age of onset of 7.4 months from his sample of ECSs. Females in the present study most commonly started to show signs of aggression at 2 months of age while males started most commonly at 6 months. This difference is most probably related to the onset of puberty in males with its associated large rise in testosterone secretion (Hart and Hart, 1985).

The types of aggression determined by cluster analysis generally fitted the classification schemes detailed by Borchelt (1983) and Beaver (1993). However, the present study did not cover all possible types of aggression; for example, pain-induced or maternal aggression were not explored. The most common type of aggression shown by the ECSs was protective (territorial) and the least common, dominance-type. This does not agree with most of the available literature on canine aggression. Dominance aggression is usually reported as the most common type of aggression treated at behavioural clinics (Beaver, 1983; Borchelt, 1983; Line and Voith, 1986; Blackshaw, 1991; Beaver, 1993) while the percentage of dogs showing territorial aggression has ranged from 5.5% of aggression cases (Beaver, 1993) to 29% (Blackshaw, 1991). However, Scott and Fuller (1965) found exceptionally low levels of social dominance in (American) Cocker Spaniels compared with some of their other breeds. In the present study, intraspecific aggression was high (28.7%) but this is not commonly treated at behavioural clinics (Borchelt, 1983; Blackshaw, 1991; Landsberg, 1991). Possessive aggression was a common form of aggression seen in the ECS and this has also been reported by Mugford (1984); however, it is not a commonly treated problem at behaviour clinics (Borchelt, 1983; Beaver, 1993) The reasons for the differences between the present data and those reported from behavioural clinics are most probably related to the owners wants or needs; that is, they want their dog to be aggressive towards strangers, to protect them, but they don't want their dog to bite them. Therefore not many protective dogs will be taken to a behaviourist. That being said, reports based on behavioural clinic cases offer a biased view on the behaviour of dogs in general; the dogs are usually showing extreme expressions of an 'abnormal' or distressing behaviour. Also, the samples are biased because only a select number of people actually take their dog to a specialist behavioural

clinic; others either tolerate the behaviour or the dog is abandoned or euthanised. Therefore, clinical data sets provide information on the types of aggression that are unacceptable to owners but do not necessarily provide any data on the prevalence of behaviour problems. Also, many of the previous studies have not taken breed differences into account. The present study overcomes these biases and puts the various types of aggression of a particular breed, into a societal context.

The results of the cluster analysis revealed that the tendency of ECSs to display aggression 'suddenly and without apparent reason' was clearly associated with other typical symptoms of dominance-type aggression. This finding offers some evidence that so-called 'rage' syndrome, which is usually characterised by its sudden and unpredictable onset, is an expression of social dominance conflicts, rather than being a separate or pathological phenomenon. Although we cannot be certain at this stage that dogs exhibiting aggression 'suddenly and without apparent reason' are actually suffering from 'rage' as it is generally defined clinically, we will be investigating this possibility further in the second stage of this project.

Breed-specific studies of canine aggression are rare. They are, however, extremely useful as a means of eliminating the potentially confounding effects of breed differences in temperament. This study provides important information on the prevalence of different types of aggression in the English Cocker Spaniel. It is also the first published study to validate scientifically the popular reports of aggressive problems with the solid, and in particular the red/golden, colour dogs. Follow-up studies will consider other factors which may be relevant to the development of aggression in this breed and to provide an answer as to whether or not 'rage' truly exists as a distinct phenomenon.

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BRIEF REPORT

Behavioral assessment of child-directed canine aggression

Ilana R Reisner, Frances S Shofer, Michael L Nance

Injury Prevention 2007;**13**:348–351. doi: 10.1136/ip.2007.015396

Objective: To characterize behavioral circumstances of bites to children by dogs presented to a veterinary behavior clinic.

Methods: Retrospective case series examining medical records of dogs presenting by referral to a university veterinary hospital for aggression and which had bitten a child <18 years old. Behavioral data included age of victim, familiarity with dog, and circumstances of bites.

Results: Records of bites to 111 children were examined. Children <6 years old were most commonly bitten in association with resource guarding (44%), whereas older children were most commonly bitten in association with territory guarding (23%). Similarly, food guarding was the most common circumstance for bites to familiar children (42%) and territory guarding for bites to unfamiliar children (53%). Behavioral screening of the 103 dogs examined revealed resource guarding (61%) and discipline measures (59%) as the most common stimuli for aggression. Anxiety screens revealed abnormalities in 77% of dogs. Potential contributory medical conditions were identified/suspected in 50% of dogs. When history before presentation was known, 66% of dogs had never previously bitten a child, and 19% had never bitten any human. Most dogs (93%) were neutered, and 66% of owners had taken their dogs to obedience training classes.

Conclusions: Most children were bitten by dogs with no history of biting children. There is a high rate of behavioral abnormalities (aggression and anxiety) in this canine population. Common calming measures (neutering, training) were not routinely effective deterrents.

Most dog bites reported to public health authorities are inflicted on children.[1] Whereas there are a number of studies reporting the epidemiologic characteristics of dog bite injury, information about the behavior of the dog or bite victim is limited.[2–4]

Veterinary behavioral medicine is a recently recognized specialty in veterinary medicine.[5 6] Data obtained in a veterinary behavior clinic can help pediatricians, parents, and other care givers to better understand the behavioral aspects of child-directed canine aggression, which, in turn, should lead to more effective prevention measures.

METHODS

The records of dogs presenting to the Behavior Clinic of the Matthew J Ryan Veterinary Hospital of the University of Pennsylvania (MJR-VHUP) for human-directed aggression from January 2002 to December 2005 were reviewed retrospectively. All cases in which the dog had bitten a child under the age of 18 years were included. However, bitten children for whom age or the circumstances of the bite were unknown were excluded.

A questionnaire, which included information about the dog, the owners' family, description of aggressive incidents as well as screening questions for aggressive and anxious behaviors exhibited by the dog, was completed by each dog owner at the time of the initial appointment. In addition to completed questionnaires and aggression and anxiety screens, each medical record included referring veterinary examination and laboratory results as well as physical examination and laboratory findings conducted at the time of the veterinary behavior consultation.

Bite occurrences were categorized by familiarity of the victim with the dog and by circumstances surrounding the event. Familiar children included members of the family and/or household, or frequent visitors who were not household members. Unfamiliar children did not live in the household and were either unknown to the dog or were infrequent visitors to the home. Circumstances of bites to familiar children included resource guarding or food guarding, benign (non-aversive) interaction, aversive but non-painful interaction, aversive and painful interaction, or interaction while the dog was resting or sleeping. Circumstances of bites to unfamiliar children were categorized relative to the dog's perceived territory (house, yard, and surrounding area), and as either interactive or non-interactive.

Statistical analysis

Data are presented using frequencies and percentages. To compare children in different age groups by biting circumstances, the Fisher exact test was used. Where applicable, data are presented as differences with 95% CI. Statistical significance was defined as $p<0.05$. All analyses were performed using SAS V.9.1 (SAS Institute, Cary, North Carolina, USA).

RESULTS

Children

A total of 145 children under the age of 18 years were bitten. Of these, 111 met inclusion criteria. Thirty four children (31%) were younger than 6 years old, and 77 (69%) were 6–17 years old. Half were boys and half were girls.

Familiar children were most commonly bitten in relation to food or resource guarding (n = 29; 26%) and "benign" interactions (n = 20; 18%) such as petting, hugging, bending over, or speaking to the dog. Presence in or entering the dog's territory was the most common situation in which unfamiliar children were bitten, regardless of whether the child was (n = 10; 9%) or was not (n = 21; 19%) actively interacting with the dog. Unfamiliar children were also bitten away from the dog's home or yard, regardless of interaction (n = 4; 4%) or lack of interaction (n = 5; 5%).

Table 1 summarizes the circumstances of the biting episode relative to both age of the child and familiarity with the dog. Children <6 years old were significantly more likely than older children to be bitten in relation to food guarding or other resource-associated aggression (44% vs 18%, difference = 26%, 95% CI 4 to 45%, p = 0.009) or in aversive, potentially pain-eliciting interactions such as stepping or falling on the dog (18% vs 0%; difference = 18%, 95% CI 7 to 35%, p = 0.0006). No differences were noted between girls and boys in any of these stimulus categories.

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Table 1 Circumstances of aggression to 111 children by dogs presented to a veterinary behavior service

Category	Stimulus description	<6 years (n = 34)	6–17 years (n = 77)	p Value
Aggression to familiar children				
Resource guarding	Approaching, reaching for or touching dog while dog is near or eating/chewing food, bone or toy	15 (44)	14 (18)	0.009
Benign (non-aversive)	Petting, hugging, kissing, bending over, reaching, speaking	5 (15)	15 (19)	NS
Resting	Waking dog; interacting while dog is resting; approaching while dog is resting/lying down; lying beside recumbent dog; pushing/pulling dog off furniture	1 (3)	8 (10)	NS
Aversive, painful	Stepping on dog; pulling on hair or body; falling on to dog; trimming nails; punishment by hitting or use of leash correction	6 (18)	0 (0)	0.0006
Aversive, non-painful	Restraint/pulling by collar; grooming, toweling feet; bathing; lifting; verbally scolding	0 (0)	5 (6)	NS
Aggression to unfamiliar children				
Territorial, non-interactive	In/on dog's territory, including house, yard, area surrounding home, car; child does not interact	3 (9)*	18 (23)	NS
Territorial, interactive	In/on dog's territory, including house, yard, area surrounding home, car; child interacts, eg, by speaking to dog, petting, reaching, attempting to feed, removing objects, restraining	2 (6)*	8 (10)	NS
Not territorial, interactive	Not on dog's territory; child interacts, eg, by speaking to dog, petting, reaching, attempting to feed, removing objects, restraining	0 (0)	4 (5)	NS
Not territorial, non-interactive	Not on dog's territory; child does not interact	1 (3)	4 (5)	NS
Aggression - other		2 (6)	7 (9)	†

Values are number (%). Columns may add up to more than total because children could have been bitten in more than one context (one child in <6-year-old group; six children in 6–17-year-old group).
*Total N = 33; cirumstances of territorial bite were unknown for one child.
†Comparison was not performed because bite circumstances varied.

Dogs

A total of 103 dogs had bitten a child under the age of 18 years. Three quarters of the dogs were male (n = 77; 75%), and all but four males and three females had been neutered. Forty one breeds were represented. English Springer Spaniels and German Shepherd Dogs each comprised 9% of pure-bred dogs (7% of all dogs), followed by 5% each of Labrador Retrievers, Golden Retrievers, and American Cocker Spaniels (4% of all dogs). The total number of times a dog had bitten (historically) was known for 98 dogs. Nineteen (19%) presented for the single bite incident involving a child, and had never previously bitten a person of any age. The remaining 79 (81%) dogs had bitten at least one person (the same child, or a different child or adult) more than once (two bites, 15%; three bites, 18%; four bites, 13%; five bites, 9%; more than five bites, 24%). When the historical details of bites before the current bite were known, 66% (n = 48) of dogs had never previously bitten a child. Forty four dogs (45%) had bitten a child who was a member of the family or household, and 65% had bitten either child or adult members of the family or household. Thirty five (35%) dogs had bitten only unfamiliar children. In some cases, histories were largely unknown because of age at acquisition.

Aggression screens completed by the owner of each dog revealed that the most common circumstance associated with aggression historically, to either adults or children, was resource guarding (61%) (table 2). Similarly, dog anxiety screening demonstrated common abnormal or reactive behavioral tendencies (table 2).

Table 2 Responses to canine aggression and anxiety screens by owners of 103 dogs presented to a veterinary behavior clinic with a history of biting children

Stimulus category	Positive (aggressive or anxious)	Negative (not aggressive or anxious)	Situation does not apply
Aggression screen			
Remove dog food, special food, toys (resource guarding)	48 (61)	31 (39)	24
Punish (verbally scold, correct with leash, hit)	24 (59)	17 (41)	62
Disturb while sleeping or resting; push or pull off furniture	38 (49)	40 (51)	25
Reach over or toward dog	34 (38)	56 (62)	13
Bathe, groom, or towel	21 (26)	59 (74)	23
Anxiety screen			
Anxiety related to separation from owner(s) while owner is absent	34 (35)	62 (65)	
Anxiety related to separation from owner(s) while owner is present but inaccessible	49 (51)	47 (49)	
Anxiety or fear related to thunderstorms/fireworks	47 (50)	47 (50)	
Any anxiety (either separation or storm/noise-related anxiety, or both)	78 (77)	23 (23)	

Values are number (%) or number. Aggression was directed to children, adults, or both. "Situation does not apply" refers to situations or provocations that do not occur for the particular dog. For example, resource guarding cannot be assessed if owners have not attempted to remove food or toys. In the aggression screen, positive responses refer to growling, baring teeth, lunging, snapping, or biting a person in response to the listed stimulus. In the anxiety screen, positive responses refer to trembling, panting, pacing, vocalization, destructiveness, urination, or defecation. Anxiety screen rows may not add up to 103 because of missing values.

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On the basis of clinical assessment, fear-related aggression was the most common primary behavioral diagnosis in the dogs (n = 90; 87%), followed by resource guarding (n = 53; 51%), territorial defense (n = 52; 51%), social conflict (n = 40; 39%), and pain (n = 14; 14%). Additional diagnoses included generalized anxiety (n = 64; 62%), inappropriate or excessive attention-seeking behavior (n = 36; 35%), and clinically significant noise or thunderstorm fear (n = 30; 29%) and separation anxiety (n = 18; 17%).

On the basis of physical examination, laboratory findings, and observation, a medical problem was identified or suspected in 51 (50%) dogs. Orthopedic (n = 18; 20% of all dogs examined) and dermatologic (n = 18; 20%) conditions were most commonly identified. Other medical problems included dermal or epidermal masses and ophthalmologic, metabolic (eg, renal and hepatic), endocrinologic, and infectious (eg, *Borrelia burgdorferi*) disease.

Most owners (66%) had taken their dogs through formal obedience training classes. Twenty one families had no prior experience, as adults, with dog ownership; however, prior experience or its lack had no significant association with biting.

DISCUSSION

In this study, we describe the circumstances surrounding bites to children by dogs evaluated for aggressive behavior at a university-based veterinary behavior service. Although the epidemiology of bitten children has been reported in a number of studies, there have been few studies on the circumstances of aggression, or behavioral or medical information about the biting dogs themselves. This is the first study to examine the behavioral aspects of child-directed canine aggression from the point of view of a veterinary behavioral assessment.

Although 66% of the evaluated dogs had no prior history of biting children, behavioral abnormalities were universally present in this canine population. Historically, although 19% of dogs had never bitten before presentation, a history of aggressive behavior other than biting (eg, baring teeth) was common. Furthermore, although some types of human-directed aggression tend to be observed only in behaviorally mature dogs (starting at 1–3 years of age),[7] aggression related to food or pain may be seen in juvenile dogs.[8] Thus, aggression even in a puppy, and even in the absence of biting, should raise concern and consideration should be given to referral for behavioral evaluation of the dog.

Anxiety screening identified abnormalities in 77% of animals. Historical evidence of fearful or anxious behavior in response to loud noises and thunderstorms or separation from the owner may signal a predisposition to biting in threatening situations related to anxiety or fear.[7] Dogs that react with anxiety to threatening stimuli may be more likely to react aggressively to children, who, particularly when very young, are at risk because of their high-pitched voices, sudden movements, and inappropriate interactions.

Medical conditions were identified or suspected in 50% of the dogs evaluated. There were a number of dogs with orthopedic, dermatologic, and other disease both at the time of consultation and historically. These associated medical or painful conditions may have increased the risk of aggression. However, because of the lack of a well-animal clinic for comparison of presented dogs, it was not possible to determine whether this was higher, lower, or as expected in the patient population. Because disease and pain can increase irritability in dogs,[9–11] even if a causal relationship is not confirmed, their presence should be an indication to separate the dog from young children until the disease has been treated or the pain reduced.

Previous reports of dog bites to children have made safety recommendations, such as neutering male dogs,[2] canine obedience training,[12] and avoiding specific breeds.[13] The prevalence of males (75%) in our study is similar to other studies.[2] Almost all dogs, both male and female, were neutered. Although our data did not include age at neutering or whether the surgery occurred before or after the appearance of aggressive behavior, it is apparent that neutering does not guarantee a reduction of aggression in dogs. It is interesting to note that the predominant canine behavioral diagnosis, fear-related aggression, lacks sexual dimorphism,[7] and therefore neither sex should be over-represented. However, even male-associated aggression such as territorial defense is unlikely to be eliminated by neutering.[14] Regardless of neuter status, parents seeking a pet dog might be advised to seek a female. Two-thirds of the dogs in this study had been taken to training classes by their owners. It is not known whether owners had made specific efforts to train or socialize dogs to be comfortable with children. Although the success of obedience training for individual dogs was not measured, the results of this study suggest that obedience training, like neutering, will not ensure prevention of future bites to children. However, the efficacy of obedience training in reducing aggression was not specifically measured. Cohort studies would be needed to evaluate whether training (or neutering) reduces biting behavior. With the exception of the English Springer Spaniel, the breeds included in our study ranked high in American Kennel Club breed registrations and appear to reflect breed popularity. Because the total number of English Springer Spaniels in our study was small, and the study was performed at a referral hospital with a highly selected group of patients, it is safest to conclude that any breed of dog is capable of biting a child.

The findings for younger children were not unexpected. Food or resource guarding is a common behavior problem in dogs and was noted in almost two thirds of the dogs in this study.[15] To be safe, children of any age should not be permitted near the dog whenever food (including human food) is present.

The meaning of ''provocation'' has been inconsistent in the literature and should be interpreted with caution.[16–19] The mere presence of a parent, who may underestimate the risk of bites to young children,[20] may not be sufficient to prevent bites.[21] Although it is natural to assume that hitting and other pain-inducing interactions can elicit aggression, parents and dog owners may be less vigilant when a child simply approaches or pets a dog. Similarly, for unfamiliar children, walking or cycling near a dog's home may be provocative enough when dogs are tethered outdoors or are not securely fenced.[22]

Our study focuses on children bitten by pet dogs evaluated in a secondary and tertiary care veterinary behavior clinic with a history of aggression to children. We recognize the limitations of a retrospective case series study at a referral center. Our patients are a highly selected group of dogs, and the ability to

Key points

- Children are at risk of dog bite in association with resource guarding by the dog or pain-causing interactions. Unfamiliar children are at risk of dog bite while in the dog's home, yard, or perceived territory, regardless of whether or not they are interacting with the dog.
- All dogs evaluated for human-directed aggression in our study had a behavior and/or medical abnormality.
- Episodes of aggression were not limited to specific dog breeds, gender, neuter status, or history of training.
- The risk of biting may be increased in the presence of pain or disease in the pet.

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draw generalizable inferences from them is limited. We also acknowledge the limitations of a retrospective study of self-report and self-assessment (of their pets) by dog owners seeking help for problem behavior. However, we do attempt to better characterize this common clinical problem from the unique perspective of the canine behavioral analysis.

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Webcast: International Forum on Quality and Safety in Health Care

Plenary sessions at this year's International Forum on Quality and Safety in Health Care were filmed and broadcast live over the internet. The sessions are still available to view free, on demand and at your own convenience at http://barcelona.bmj.com. Each session is accompanied by a panel discussion.

The webcast includes the following, in either English or Spanish translation:

- **Donald M Berwick**: Can health care ever be safe?
- **Richard Smith:** What the quality movement can learn from other social movements
- **Lucian Leape and Linda Kenney:** When things go wrong: communicating about adverse events
- **John Prooi and Harry Molendijk:** Partnering for patient safety

Signalment factors, comorbidity, and trends in behavior diagnoses in dogs: 1,644 cases (1991–2001)

Michelle Bamberger, MS, DVM, and Katherine A. Houpt, VMD, PhD, DACVB

Objective—To determine trends in behavior diagnoses; assess the relationship between diagnoses and age, sex, reproductive status, and breed; and evaluate associations between diagnoses within the same dog (comorbidity).

Design—Retrospective case series.

Animals—1,644 dogs.

Procedures—Medical records of dogs evaluated for behavioral problems were reviewed for breed, sex, reproductive status, consultation year, birth date, and diagnoses.

Results—Numbers of dogs with aggression, anxiety, and unruly behavior increased over the course of the study, as did the total number of dogs evaluated for behavioral problems. In general and for aggression, Dalmatians, English Springer Spaniels, German Shepherd Dogs, and mixed-breed dogs were evaluated more often than expected, whereas Labrador Retrievers and Golden Retrievers were evaluated less often than expected. Labrador Retrievers were also underrepresented for anxiety, whereas mixed-breed dogs were overrepresented. Males were overrepresented except for interdog aggression, anxieties, and phobias, whereas females were overrepresented for phobias. Dogs with phobias were evaluated at a median age of 6.5 years, compared with dogs with other problems (median age, 2.5 years). A mean of 1.6 diagnoses/dog was observed, with certain diagnoses clustered.

Conclusions and Clinical Relevance—Results suggested that in dogs, behavioral problems changed over the course of the study; age, sex, and breed distributions varied among diagnoses; and certain diagnoses were likely to occur together. (*J Am Vet Med Assoc* 2006;229:1591–1601)

Owners' perceptions of behavioral problems in dogs as well as practitioners' interest in managing behavioral problems may lead to changes over time in the numbers and types of cases evaluated by general practitioners and referred to major university centers. An understanding by general practitioners of current trends as well as age, sex, and breed distributions of such dogs may aid them in making the correct diagnosis. Knowledge of comorbidity may also help the practitioner focus questions during evaluation of the dog's history, resulting in a more efficient consultation. With such knowledge, general practitioners can educate their clientele, who may then be more likely to report behavioral problems and seek resolution. Also, if educators understand current behavioral trends and case demographics, clinical training of veterinary students as well as continuing education may be benefited.

Abbreviations

ABC	Animal Behavior Clinic at Cornell University
CUHA	Cornell University Hospital for Animals

Behavioral problems have been evaluated via owner surveys[1-8,a,b] as well as case-review studies.[9-20] Several studies[4,8,a] based on owners' opinions have revealed unruly behavior (barking and jumping up) as the most common problem confronting dog owners, whereas others have revealed house soiling[2,3,5,b] or nonbehavioral concerns (sadness when the pet dies, finding care when away, and shedding)[6,7] as the primary problem. In contrast, results of most canine case studies[9-15,17,18,20] indicate that aggression is the most prevalent behavioral diagnosis in dogs. Reports of several studies describe age, sex, and breed distributions in dogs with behavioral problems[1,4,6,7,9-14,17-21] and associations among diagnoses.[11-18]

Most behavioral studies involve analysis of data during a specified period and do not evaluate trends over time, although a few have evaluated monthly and seasonal trends in overall behavioral problems[10,b] or have provided yearly overview data[2,3,5-7,10] with some analysis from year to year.[7,10] The primary objective of the study reported here was to determine trends in behavior diagnoses made at the ABC from 1991 to 2001. Secondary objectives included assessing the relationship between behavior diagnoses and signalment factors (age, sex, reproductive status, and breed), assessing the distribution of these factors over time, and evaluating comorbidity.

Criteria for Selection of Cases

Medical records for 1,668 dogs evaluated at the ABC from January 1, 1991, through December 31, 2001, were evaluated for this study; 24 dogs were excluded from the population because of incomplete data; therefore, 1,644 dogs were included in the study.

Procedures

Data on breed, sex, reproductive status, consultation year, birth date, and behavior diagnoses were gathered on each dog. A maximum of 3 diagnoses were

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taken for each dog; these diagnoses were the first 3 listed in the record. Dogs (n = 57,196) evaluated at the CUHA over the same period served as the reference population for breed, sex, reproductive status, and age comparisons. Breed, sex, reproductive status, and age data from the reference population were gathered independently. Over the entire study, a breed was assigned to all dogs and sex and reproductive status were specified for > 98% of the dogs. The owners were able to specify the age in 75% of the dogs. Ninety-six individual diagnoses taken from original records were assigned to the following general categories: aggression, anxieties, locomotor behaviors, ingestive behaviors, self-directed aggression, grooming behaviors, fears, house soiling, phobias, sexual behaviors, unruly behaviors, vocalization behaviors, and miscellaneous behaviors (cognitive dysfunction, depression, pseudocyesis, psychogenic salivation, and hyperesthesia syndrome; **Appendix**). Individual diagnoses listed under the general categories of aggression, fears, and house soiling were divided into several subcategories. In the aggression category, subcategories were defined by target; defined as people (owners or strangers), animals, and things; and then further defined into individual diagnoses by motivation or etiology. Fears were grouped into subcategories by triggers as fear of people, animals, or situations. House soiling diagnoses were placed into either marking or elimination subcategories.

Statistical analysis—Diagnoses were analyzed on the levels category, subcategory, and individual. For any given level of diagnosis, no dog was counted more than once. Each diagnosis was initially evaluated by determining the number of dogs with that diagnosis over the 11-year study period, compared with the total number of dogs with any diagnosis, and expressing this as a percentage value. Each diagnosis assigned to an absolute number of 32 or more dogs over the entire study was then analyzed for trends over time and, secondarily, for the relationships between diagnoses and age, sex, reproductive status, and breed. Diagnoses assigned to < 32 dogs over the entire study typically had 2 or fewer dogs in most years, making analysis of trends over time difficult or impossible. Where an individual diagnosis was assigned to ≥ 95% of the dogs in a particular subcategory (eg, barking comprised 97.7% of the vocalization cases), only the subcategory was reported and discussed because the results (relationship with age, sex, reproductive status, and breed) were the same. To detect trends over time for all diagnoses, a least squares linear regression was performed by use of the square root of the number of cases (ie, the No. of dogs with a specific diagnosis) within a given year as the dependent variable and the year of diagnosis as the independent variable.[22,23] A trend was defined as a slope that was significantly ($P < 0.05$) different from 0. An upward trend in a diagnosis was defined as an increasing annual percentage of total cases over time (positive slope), and a downward trend in a diagnosis was defined as a decreasing annual percentage of total cases (negative slope). A square root transformation was used to normalize errors in the data set.[23,24] To detect trends over time for each diagnosis, logistic regression was performed by use of a proportion (the No. of cases of that particular diagnosis in a given year divided by the total No. of cases in that year) as the dependent variable and the year of diagnosis as the independent variable. Because the dependent variable was a proportion and not a direct count, logistic regression was used instead of linear regression.[22,25] Neither regression was weighted because no individual value for a dependent variable was more important than any other.[26]

To determine the relationship between the age of dogs and each diagnosis, descriptive statistics (median and interquartile range) were first calculated for all dogs with each diagnosis over the 11-year study period as well as for all remaining dogs (dogs that did not have that diagnosis) over the same period. Median and interquartile range were used because the histogram of the number of cases (1-year bins) versus age did not follow a Gaussian distribution.[26] To determine whether a significant difference between the ages of these 2 groups (dogs with a diagnosis and those without) existed, the log of the age was compared by use of a 2-sample *t* test[22] to more closely approximate a Gaussian distribution. To determine clinical importance, a difference of > 2 years was set to account for dogs in which age was estimated. These same methods were also used over all diagnoses for use of breed (mixed breed vs purebred), sex, and reproductive status as grouping variables. To assess the relationship between age of dogs over all diagnoses from year to year, the median age was determined for each year and a least squares linear regression was performed with the median age for each year as the dependent variable and the year of diagnosis as the independent variable.

To assess the relationship between the caseload (the total No. of dogs evaluated) and sex of dogs over the study period, the percentage of total dogs for total (intact and neutered), sexually intact, and neutered males as well as total, sexually intact, and spayed females was determined. The 2-sample proportion test was used to compare percentages between males and females and between sexually intact and neutered dogs within the ABC population; this test is used to compare proportions in 2 independent samples.[22] Between the ABC and CUHA populations, the 1-sample proportion test was used to compare total males with total males, castrated males with castrated males, and spayed females with spayed females; the corresponding proportion in the CUHA population was treated as fixed and was used to define the null hypothesis for this test. The 1-sample proportion test is used to test whether a proportion differs from a hypothesized value.[22] To assess the relationship between the caseload and sex of dogs from year to year, the percentage of total dogs for total males, neutered males, and spayed females was determined for each year and analyzed by use of logistic regression; regressions between the ABC and the CUHA populations were compared by use of a Wald test that treated the CUHA population as fixed. Specifically, a test statistic for the equality of slopes was computed by taking the absolute value of the difference of the slopes from the 2 regressions divided by the SE of the slope in the ABC population.[25] A 2-tailed *P* value was then computed by use of a normal distribution.

To assess the relationship between the caseload and breed of dog during the total study period, the percentage of total dogs of each breed (total No. of dogs of each breed divided by all dogs of all breeds) during the study was determined. Breeds with ≥ 30 dogs during the study were compared with the percentage of total dogs of each breed of CUHA dogs during the same time by use of a 1-sample proportion test. The relationship between each diagnosis and breed of dog was analyzed in the same manner; the percentage of total dogs of the 4 top breeds (including mixed breed) in each diagnosis was compared with the percentage of total dogs of the same breeds evaluated by the CUHA over the same time by use of a 1-sample proportion test. To assess the relationship between the caseload and breed of dog from year to year, the percentage of total dogs for breeds with 30 or more dogs over the study was analyzed via logistic regression; regressions between the ABC and CUHA populations were compared in the same manner as described previously.

The level of association between 2 diagnoses occurring within the same dog was assessed by first determining the probability of each diagnosis given that the other diagnosis was present. The significance of this association was then evaluated by use of the Pearson χ^2 test.[22,26]

All analyses were performed with standard software.[c] All tests were 2-tailed, and values of $P < 0.05$ were considered significant.

Results

The number of dogs evaluated at the ABC increased significantly ($P = 0.002$) between 1991 and 2001 (**Figure 1**). This trend was also seen in the CUHA population over the same period (slope of the regression line = 1.114; SE = 0.14; $r^2 = 0.87$; $P < 0.001$); a significant ($P < 0.001$) difference was found between the ABC and CUHA populations when regressions were compared—the CUHA population increased at a greater rate than the ABC population.

Distribution of diagnoses—The number of dogs affected by each diagnosis (and percentages, compared with the total No. of affected dogs) for all major category diagnoses and all diagnoses that affected ≥ 32 dogs/y over the study period were determined (**Table 1**). Because each dog may have had up to 3 diagnoses, the sum of the individual percentages was > 100%. The category of aggression accounted for the largest percentage of affected dogs during the study period, followed by anxieties, unruly behavior, house soiling, phobias, excessive vocalization behavior, abnormal ingestive behavior, abnormal locomotor behavior, miscellaneous, fears, self-directed aggression, grooming behavior, and sexual behavior.

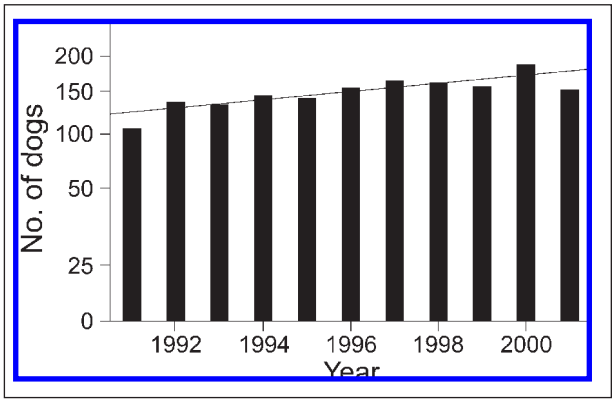

Figure 1—Plot of the number of dogs evaluated for behavioral problems at the ABC from 1991 to 2001. The y-axis is scaled as the square root of the number of dogs. The straight line represents the linear regression line for the data (slope = 0.214; SE = 0.05; $r^2 = 0.67$; $P = 0.002$).

Trends in diagnoses—Trends were detected for several diagnoses (**Table 2**). In the category of aggres-

Table 1—Distribution (number of affected dogs [%]) of diagnoses among 1,644 dogs evaluated for behavioral problems at the ABC from 1991 to 2001.

Diagnosis	No. of dogs (%)
Aggression	1,191 (72.4)
People-directed aggression	997 (60.6)
Owner-directed aggression	724 (44.0)
Dominance-related aggression	667 (40.6)
Fear aggression directed at owners	85 (5.2)
Stranger-directed aggression	535 (32.5)
Fear aggression directed at strangers	276 (16.8)
Territorial aggression	339 (20.6)
Animal-directed aggression	304 (18.5)
Interdog aggression	268 (16.3)
Anxieties	324 (19.7)
General anxiety	93 (5.7)
Separation anxiety	236 (14.4)
Locomotor behavior	16 (1.0)
Ingestive behavior	23 (1.4)
Self-directed aggression	8 (0.5)
Grooming behavior	9 (0.5)
Fears	11 (0.7)
House soiling	124 (7.5)
Elimination	117 (7.1)
Urination and defecation	99 (6.0)
Miscellaneous	14 (0.9)
Phobias	64 (3.9)
Storm phobia	37 (2.3)
Sexual behavior	2 (0.1)
Unruly behavior	201 (12.2)
Attention-seeking behavior	126 (7.7)
Destructive behavior	40 (2.4)
Vocalization behavior	45 (2.7)
Barking	44 (2.7)

Percentages do not add to 100% because each dog may have had up to 3 diagnoses. Major category diagnoses and all other diagnoses with > 32 cases/y over the study period are listed.

Table 2—Results of logistic regression analysis of the frequency of various behavior diagnoses in dogs from 1991 to 2001.

Diagnosis	Slope	SE	*P* value
Dominance-related aggression	–0.038	0.016	0.019
Fear aggression directed at owners	0.142	0.039	< 0.001
Stranger-directed aggression	0.122	0.018	< 0.001
Fear aggression directed at strangers	0.199	0.024	< 0.001
Anxieties	0.141	0.021	< 0.001
General anxiety	0.171	0.038	< 0.001
Separation anxiety	0.107	0.024	< 0.001
House soiling	–0.097	0.031	0.002
Elimination	–0.104	0.031	0.001
Urination and defecation	–0.145	0.035	< 0.001
Unruly behavior	0.069	0.025	0.006
Attention-seeking behavior	0.263	0.037	< 0.001
Destructive behavior	–0.135	0.053	0.011

Slope = Slope of the regression line. *P* value indicates comparison with a slope of 0.

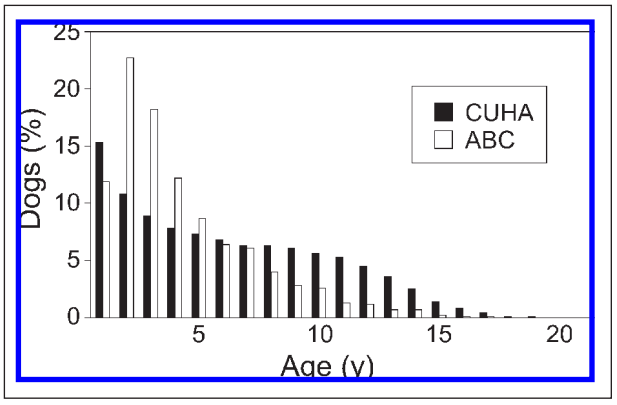

Figure 2—Distribution of ages (%, compared with overall population) among dogs evaluated for behavioral problems at the ABC and all dogs evaluated at CUHA (reference population).

Table 3—Distribution of sexes for dogs with various behavior diagnoses from 1991 to 2001.

Diagnosis	Male (%)	Female (%)
All diagnoses	56.6*	43.4
Aggression	60.1*	39.9
People-directed aggression	64.6*	35.4
Owner-directed aggression	66.2*	33.8
Dominance-related aggression	67.8*	32.2
Stranger-directed aggression	64.7*	35.3
Fear aggression directed at strangers	56.5*	43.5
Territorial aggression	68.4*	31.6
Animal-directed aggression	44.7	55.2†
Interdog aggression	42.5	57.5†
Anxieties	45.0	54.9†
General anxiety	24.7	75.3*
Phobias	39.1	60.9†

*Significantly ($P \leq 0.05$) greater than values in the opposite sex in the ABC population and values for the same sex in the corresponding reference CUHA population. †Significantly ($P \leq 0.05$) greater than values in the opposite sex in the ABC population only. For the CUHA population, percentages of male and female dogs were 48.5% and 51.5%, respectively.

sion, upward trends were seen in fear aggression directed at owners, stranger-directed aggression, and fear aggression directed at strangers. A downward trend was found in dominance-related aggression. Upward trends were also detected in anxieties as well as in general and separation anxiety. Downward trends were observed in house soiling, elimination, and urination and defecation. Upward trends were observed in unruly and attention-seeking behaviors, whereas a downward trend was observed in destructive behavior.

Relationship between diagnoses and age—The distribution of age for the CUHA population differed from that of the ABC population (**Figure 2**). Because of differences between the 2 populations, the relationship between age and diagnosis was determined by making comparisons within the ABC population (dogs with the diagnosis vs dogs without the diagnosis). Overall, median age at evaluation was 2.5 years, mean age was 3.7 years, and interquartile range was 1.5 to 5.5 years. Because exact age was estimated to the nearest month or year in some dogs, only diagnoses in dogs with an age difference (between dogs with the diagnosis and those without) of > 2 years were considered to have clinical importance. Only phobias (median age, 6.5 years; interquartile range, 4.8 to 9.5 years) and storm phobia (median age, 6.5 years; interquartile range, 5.5 to 9 years) were significantly ($P < 0.001$) different between dogs with the diagnosis and dogs without the diagnosis (median age, 2.5 years; interquartile range, 1.5 to 4.5 years) and considered clinically important. No difference was detected in median ages from year to year; corresponding data from the CUHA also yielded no difference in median ages.

Relationship between diagnoses and sex—Sex differences among dogs with various diagnoses were determined (**Table 3**). Overall, more total male dogs and more neutered dogs were seen in the ABC population, compared with the CUHA population. Sex differ-

Table 4—Distribution (%) of breeds in a reference (CUHA) population and among dogs with various behavior diagnoses evaluated at the ABC from 1991 to 2001.

Breed	CUHA	All diagnoses	Aggression	Anxiety	House soiling	Phobias	Unruly behavior	Vocalization
Beagle	1.9			3.4	5.6*			
Bichon Frise	0.7				4.8*			
Cairn Terrier	0.6							8.9*
Cocker Spaniel	3.8	2.9			6.5			
Dachshund	1.2							4.4
Dalmatian	1.0	2.6*						
Doberman Pinscher	1.7							4.4
English Springer Spaniel	1.7	4.1*	5.2*					
German Shepherd Dog	4.8	5.8*	6.5*	4.0		6.3	4.5	4.4
Golden Retriever	5.5	3.3†				7.8	5.5	
Jack Russell Terrier	0.8							4.4*
Labrador Retriever	9.5	4.9†	4.5†	5.6†		4.7	8.5	4.4
Miniature Dachshund	0.3							4.4*
Rottweiler	2.4	2.2						
Shetland Sheepdog	1.5							8.9*
Mixed	24.7	30.7*	29.6*	39.2*	22.6	34.4	32.8*	24.4

For the CUHA population, values indicate percentage distribution of dogs for each breed.
*Significantly ($P \leq 0.05$) greater than that of the corresponding CUHA population. †Significantly ($P \leq 0.05$) less than that of the CUHA population. All diagnoses = breeds with 30 or more cases; for all other diagnoses, values are given for the top 4 breeds with regard to the number of dogs with each diagnosis, except for the category vocalization, for which the diagnosis was equally evident in > 4 breeds.

ences were observed in the categories of aggression, anxieties, and phobias, with more total males in most of the aggression diagnoses categories but more total females in the interdog aggression, anxieties, and phobias categories. General anxiety was the only diagnosis for which the percentage of neutered dogs (males) was not higher than the corresponding percentage in the CUHA population. The only change in sex or reproductive status over time was an upward trend in spayed females (slope of the regression line, 0.044; SE = 0.017; $P = 0.009$). A similar trend was observed in the CUHA population (slope of the regression line, 0.036; SE = 0.003; $P < 0.001$). There was no significant difference when these regressions were compared ($P = 0.646$).

Relationship between diagnoses and breed—For breeds that had ≥ 30 dogs with any diagnosis and for breeds with the 4 highest percentages of dogs with each category of diagnosis, the percentages of affected dogs, compared with all affected dogs, were determined for the ABC population; corresponding percentages for these breeds were also determined for the CUHA population (**Table 4**). Across all diagnoses, affected Dalmatians, English Springer Spaniels, German Shepherd Dogs, and mixed-breed dogs constituted a significantly higher percentage of the total number of dogs in the ABC population, compared with the CUHA population; cases involving Golden Retrievers and Labrador Retrievers constituted a lower percentage of the total number of cases. With regard to breed distribution for all diagnoses over time, an upward trend was detected in mixed-breed dogs and a downward trend was detected in Cocker Spaniels, English Springer Spaniels, and German Shepherd Dogs (**Table 5**); these trends were also detected in the CUHA population. When regressions between the ABC and CUHA populations were compared, significant differences were detected in mixed-breed dogs ($P = 0.012$) and English Springer Spaniels ($P < 0.001$). In both breeds, the ABC population changed at a faster rate than did the CUHA population.

Table 5—Results of logistic regression analysis of various breeds of dogs evaluated at the ABC (1991–2001) versus year, and analysis of breed versus year in a reference population of dogs at the CUHA.

Population	Slope	SE	*P* value
ABC			
Mixed breed	0.061	0.017	< 0.001
Cocker Spaniel	–0.107	0.048	0.025
English Springer Spaniel	–0.083	0.041	0.04
German Shepherd Dog	–0.071	0.036	0.046
CUHA			
Mixed breed	0.019	0.003	< 0.001
Cocker Spaniel	–0.018	0.007	0.007
English Springer Spaniel	–0.06	0.01	< 0.001
German Shepherd Dog	–0.031	0.006	< 0.001

P value indicates comparison with a slope of 0.

Comorbidity—Of all dogs, 55.4% had 1 diagnosis, 26% had 2 diagnoses, and 18.6% had ≥ 3 diagnoses made at the time of evaluation. The mean number of diagnoses per dog was 1.6, and certain diagnoses occurred in clusters. Significant associations between 2 diagnoses were detected (**Table 6**). Most of the significant associations involved cases with both diagnoses from the aggression category.

Discussion

Aggression was diagnosed in nearly 75% of all dogs evaluated, mostly because of aggression directed at humans (mostly owners) rather than other animals. Dominance-related diagnoses accounted for the majority of owner-directed aggression (92%), whereas fear aggression directed at owners accounted for most of the remaining cases. Clearly, owner-directed aggression has been[10,19,27-31,d] and continues to be a difficult problem for veterinarians and owners to manage. Although not as prevalent as aggression, anxieties are often considered to be the next most frequently reported problem, with separation anxiety being the most commonly seen problem in this category.[10,13]

Upward trends were detected in several diagnoses in the categories of aggression (stranger-directed aggression, fear aggression directed at strangers, and fear aggression directed at owners) and anxieties (general and separation). It is imperative that veterinarians, in training and at the level of continuing education, be aware of current behavioral problems and understand how to advise clients in prevention and management. This is especially important in the case of stranger-directed aggression, for which upward trends may be a sign of the increasingly litigious nature of society. It is

Table 6—Associations between pairs of diagnoses in 1,644 dogs evaluated at the ABC from 1991 to 2001.

Diagnosis 1	Diagnosis 2	No.	D1	D2	*P* value
Fear aggression directed at strangers	Territorial aggression	105	276 (38.0)	339 (30.9)	< 0.001
Fear aggression directed at owners	Fear aggression directed at strangers	56	85 (65.9)	276 (20.3)	< 0.001
Dominance-related aggression	Fear aggression directed at owners	52	667 (7.8)	85 (61.2)	< 0.001
Dominance-related aggression	Interdog aggression	47	667 (7.0)	268 (17.5)	< 0.001
Interdog aggression	Territorial aggression	37	268 (13.8)	339 (10.9)	0.003
Dominance-related aggression	Separation anxiety	21	667 (3.1)	236 (8.9)	< 0.001
Fear aggression directed at strangers	Separation anxiety	17	276 (6.2)	236 (7.2)	< 0.001
Dominance-related aggression	General anxiety	15	667 (2.2)	93 (16.1)	< 0.001
Territorial aggression	Separation anxiety	10	339 (2.9)	236 (4.2)	< 0.001
Noise phobia	Separation anxiety	10	27 (37.0)	236 (4.2)	< 0.001
General anxiety	Interdog aggression	6	93 (6.5)	268 (2.2)	0.008

No. = Number of dogs with both diagnoses. D1 = Number of dogs with diagnosis 1 (percentage of dogs that also had diagnosis 2 in parentheses). D2 = Number of dogs with diagnosis 2 (percentage of dogs that also had diagnosis 1 in parentheses). The last column gives the value of *P* as determined by the Pearson χ^2 test.

interesting that the percentage of dominance-related aggression cases decreased over time. This may be partially because of trends in current terminology. Few studies have tracked caseloads over extended periods of time. However, in a review of canine cases in 2000,[10] the referral rate of status-related aggression had declined and fear aggression had increased since 1996; these results support our findings. Although Appleby et al[10] reported a decline in the referral rate for separation anxiety from 1996 to 2000, an increase among dogs obtained from rescue was detected. In the study reported here, the upward trends detected in separation anxiety may have been attributable to greater awareness of this problem by veterinarians as well as pet owners and the emergence during this time period of an approved medication to treat separation anxiety.[32]

Breed incidence of behavioral problems varies depending on many factors including breed distribution, sample size, geographic location, time of study, reference population, and source of puppies. When a behavioral problem has been clearly identified within a breed, it is important that veterinarians, breeders, dog owners, and prospective owners be alerted that such problems exist. Overall, in our study, many more (30.7%) dogs of mixed breed (unknown crosses as well as known crosses) were evaluated than dogs of any pure breed, although purebred dogs as a group were more than twice as numerous as mixed-breed dogs. This was also true of the CUHA population that included 24.7% mixed-breed dogs and has been reported by others.[13,17,20,31] Golden Retrievers and Labrador Retrievers were underrepresented in general and specifically for aggression problems, whereas Dalmatians, English Springer Spaniels, German Shepherd Dogs, and mixed-breed dogs were overrepresented in these areas. Some or all of the breeds in the latter group have also been reported more frequently by others for general problems[11,17,27,33,34] as well as for aggression.[1,11,13,17,27,30,33-35] In our study, Beagles, Dalmatians, and mixed-breed dogs had separation anxiety more often than expected and the number of mixed-breed dogs (n = 104) with separation anxiety far outnumbered the group of purebred dogs (17) with separation anxiety. However, breed distribution of separation anxiety varies among previous studies. Results implicate mixed-breed dogs[35] and purebred dogs[c] as being evaluated more frequently than expected or that there is no difference between these groups.[36]

Regarding the incidence of all diagnoses over the study period for various breeds, an upward trend was detected in mixed-breed dogs and downward trends in Cocker Spaniels, English Springer Spaniels, and German Shepherd Dogs. These trends were also seen in the CUHA population, but changes in incidences of all diagnoses in mixed breeds and English Springer Spaniels were significantly greater in the ABC population. It is important to note that all of these breeds except Cocker Spaniels were evaluated more often than would be expected for many diagnoses in the aggression category; perhaps the popularity of these breeds in our geographic location has decreased because of behavioral problems such as aggression.

In addition to breed distribution, veterinarians and owners need to know at what age certain problems are more likely to appear to prevent them altogether or to diagnose them in the early stages of development. Median age at evaluation of all dogs for behavior problems was 2.5 years, and mean age was 3.7 years. Others have reported similar findings[17,18,21] or found that the largest age categories included these ages.[9,10,13] In the study reported here, phobias and storm phobias occurred at a median age of 6.5 years, compared with a median age of 2.5 years for all other diagnoses. Landsberg[17] did not analyze differences among ages in various diagnoses but reported that all diagnoses occurred at a mean of 2 to 3 years of age, except for phobias, which occurred at a mean of 5 years of age. The older age at evaluation implies that learning plays an important role in development of phobias in dogs, even more so than in other diagnoses, for which median ages ranged from 2.5 to 3.5 years. In assessing age distribution over time, median ages for a given year were remarkably static because all were 2.5 years except the year 1992, for which median age at evaluation was 3.5 years.

It is also necessary to understand whether sex plays a role in development of problem behaviors. In the study reported here, males were evaluated more often than expected overall and for many aggression problems (56.6% overall; 60.1% aggression); others have reported similar results.[1,9-14,17-21,27,28,30,33-35,37-39,d] Neutered dogs were evaluated more frequently than sexually intact dogs by more than a factor of 4, which was most likely because male and female dogs are often routinely castrated and spayed before puberty. For most behavior diagnoses, neutered dogs were also evaluated more often than expected, compared with the CUHA population. Although similar findings have been reported in recent studies,[10,13,14] other studies covering periods before neutering is typically performed have detected a preponderance of sexually intact males[20,37,d] or sexually intact males and spayed females[11,18,34] evaluated for aggression. It is important to note that animal-directed and interdog aggression (including household and nonhousehold aggression) were the only aggression diagnoses for which females were evaluated more often than expected in our study. However, reported sex differences in interdog aggression vary. Some authors have found that males are more likely to fight than females, especially with other males,[11,33] whereas others have found no sex differences.[17] Sherman et al,[40] using data from 3 of the years (1991 to 1993) reported in our study, determined that females are more likely to initiate interdog household aggression, whereas males are more likely to attack nonhousehold dogs. We also found that females were evaluated more often than males for anxieties, general anxiety, and phobias. Lund et al[21] reported that males had a significantly lower risk of general anxiety, and Appleby et al[10] reported that phobic behavior was higher in females in the 1994 caseload analysis. However, Overall et al[41] found that there was no sex difference in regard to the relative percentage of total cases of thunderstorm phobia, noise phobia, and separation anxiety (discrepancy may be attributable to higher sample size of the present study). Numbers of spayed females increased over the study in the ABC population as well

as the CUHA population, with a significantly greater change seen in the ABC population; this difference was most likely attributable to more sexually intact females being evaluated at CUHA because of referrals for reproductive problems.

In the study reported here, certain diagnoses occurred together more often than chance would predict. The practitioner could use this knowledge during evaluation of the dog's history to help focus questions and uncover problems of which even the owner may have been unaware. The highest number of combinations of diagnoses occurred within the category of aggression, and the next most frequently occurring group of combinations was diagnoses in the aggression and anxiety categories. Owners with dogs with fear aggression toward strangers should be questioned specifically on issues of fear aggression toward family members because these diagnoses are often associated. Also, contexts and postures during aggressive incidents in the home should be clearly defined because we found an association with fear in dogs with dominance-related aggression. Dogs that fight with other dogs may also have issues in the home with owners (dominance-related) or with strangers (territorial). We found 6 pairs of aggression-anxiety diagnoses in at least 6 dogs over the study. This is not surprising because anxiety may lower a dog's threshold for aggression.[42,43] Because of this, dogs with aggression (dominance-related, fear towards strangers, interdog, and territorial) should be observed carefully during the consultation for signs of anxiety and inability to relax,[44] and owners should be questioned for signs of separation anxiety or general anxiety in their dogs. Noise phobia and separation anxiety also occurred together more often than chance would predict. Such results have been reported in 2 other studies.[36,41] It is important to keep in mind that these data represent only those dogs referred to veterinary behaviorists and that breed distributions reported in this study do not necessarily reflect breed prevalence of behavioral problems.

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Appendix
Definitions of behavioral diagnoses for cats and dogs.

Aggression—a general term that includes all features of defense, threat, and attack behavior directed at people, animals, or things and excludes all features of affiliative behavior.

People-directed

Owner-directed

Dominance-related aggression—formerly known as dominance aggression, also known as conflict-related, impulse/control, and status-related aggression; includes 2 or more of the following signs: growling, barking aggressively, blocking, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at owners or family members over control of resources such as space, food, possessions, proximity to owner, or situations.

Aggression to children—includes 2 or more of the following signs: growling, barking aggressively, blocking, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at familiar children.

Fear—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at owners and accompanied by attempts to escape; fearful postures such as tucked tail, crouched body, or supine with abdomen exposed; and flattened or pinned ears. This aggression may occur in any location, either on or off the owner's property or in both locations.

Herding—nipping, barking, and biting at the feet and ankles in an attempt to move owners in 1 direction.

Idiopathic—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at owners for which no medical or behavioral stimulus or cause has been discovered.

Irritable—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at owners in response to a broad range of situations, such as stress, frustration, or pain.

Noise-triggered aggression—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, or biting (dogs) or hissing, growling, and biting (cats) directed at owners that is solely initiated by a sound.

Pain-based—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) that may be triggered by an action, either internal or external to the pet, that the pet perceives as painful and that is directed at the owner.

Petting-induced aggression—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at a person after a certain number of pets to the animal's head or body.

Play—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at the owner or family members during a play session.

Predatory—stalking and hunting accompanied by attempts to kill or killing directed at owners, usually infants.

Redirected—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting directed at the owner when a pet is prevented from pursuing aggressive behavior directed at another target.

Stranger-directed

Aggression to children—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at unfamiliar children.

Fear—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at strangers and accompanied by attempts to escape and fearful postures such as tucked tail, crouched body or supine with abdomen exposed, and flattened or pinned ears. This aggression may occur in any location, either on or off the owner's property, or in both locations.

Idiopathic—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at strangers, for which no medical or behavioral stimulus or cause has been discovered.

Irritable—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at strangers in response to a broad range of situations, such as stress, frustration, or pain.

Pain-based—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) that may be triggered by an action, either internal or external to the pet, that the pet perceives as painful and that is directed at a stranger.

Petting-induced aggression—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at a stranger after a certain number of pets to the animal's head or body.

Play—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at strangers during a play session.

Predatory—stalking and hunting accompanied by attempts to kill or killing directed at strangers, usually infants.

Redirected: includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at a stranger when a pet is prevented from pursuing aggressive behavior directed at another target.

Territorial—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) directed at strangers on the owner's property or what the animal considers to be the property.

Animal-directed

Fear—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at animals and accompanied by attempts to escape and fearful postures such as tucked tail, crouched body or supine with abdomen exposed, and flattened or pinned ears. This aggression may occur in any location, either on or off the owner's property, or in both locations.

Intercat—includes 3 or more of the following signs: staring, blocking, hissing, vocalizing, stalking, swatting, lunging, and biting among 2 or more cats within a household or among cats from different households.

Interdog—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting among 2 or more dogs within a household or among dogs from different households.

Interspecies—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at another species (exclusive of people) within the household or outside of the household, exclusive of predation.

Play—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, or biting (dogs) or hissing, growling, and biting (cats) directed at other animals, exclusive of people during a play session.

Predatory—stalking and hunting accompanied by attempts to kill or killing other animal species, exclusive of people.

Redirected—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting (dogs) or hissing, growling, and biting (cats) directed at another animal when a pet is prevented from pursuing another aggressive behavior.

Thing-directed

Aggression to cars—includes 2 or more of the following signs: growling, barking aggressively, snapping, snarling, lunging, and biting directed at parked or moving cars.

Appendix
Definitions of behavioral diagnoses for cats and dogs (continued).

Anxieties—conditions resulting from the anticipation by the animal of danger or harm.
- **Anxiety-related pruritis**—itching occurring during situations of stress, frustration, or conflict and having no medical cause.
- **Barrier frustration**—inability to stay or be enclosed or confined in any way without extreme anxiety.
- **General anxiety**—increased vigilance, motor activity, and autonomic activity that interfere with normal functioning.
- **Hyperattachment**—remaining within sight or touch of the owner at all times.
- **Separation anxiety**—includes 1 or more of the following signs: destructive behavior, vocalization, salivation, and elimination caused by physical or visual separation from the owner.
- **Travel anxiety**—increased vigilance, motor activity, and autonomic activity during any type of travel.

Locomotor behavior—out of context, repetitive body movements that are difficult or impossible to interrupt and interfere with the animal's normal routine.
- **Circling**—repetitive walking or running in a circular pattern for no apparent reason.
- **Light chasing**—following light from any source in attempt to catch it, such that normal function is interfered with.
- **Shadow chasing**—following shadows produced by any source in attempt to catch them, such that normal function is interfered with.
- **Tail chasing**—repetitive and excessive chasing of the tail that may or may not result in alopecia, abrasions, or ulcerations.

Ingestive behavior—out of context, repetitive oral movements that are difficult or impossible to interrupt and interfere with the animal's normal routine and abnormal appetite or abnormal ingestion of nonfood items.
- **Air biting**—repetitive snapping at the air for no obvious reason, exclusive of normal activities.
- **Abnormal suckling**—preference by an animal to suckle on a human finger, body part, or clothes.
- **Anorexia**—loss or lack of the appetite for food.
- **Chewing telephone cords**—repetitive chewing with the molars on telephone cord or wires.
- **Cloth chewing**—repetitive chewing with the molars on cloth material.
- **Coprophagy**—ingestion of feces.
- **Excessive chewing**—repetitive mastication when there are no longer any food materials in the mouth.
- **Fabric licking**—repetitive and excessive licking of cloth material.
- **Foraging**—searching for food.
- **Hyperphagia**—eating a greater than optimal quantity of food.
- **Pica**—ingestion of a variety of nonfood items and not limited to 1 particular substrate.
- **Psychogenic polydipsia**—drinking of excessive amounts of water because of stress and not because of a medical condition.
- **Wood chewing**—repetitive chewing with the molars on wood or wooden material.
- **Wool chewing**—repetitive chewing with the molars on woolen material.
- **Wool sucking**—repetitive sucking on woolen material.

Self-directed aggression—repetitive oral or body movements that are self-afflicted, cause the animal severe harm, are difficult or impossible to interrupt, and interfere with the animal's normal routine.
- **Self-mutilation**—repetitive and excessive actions that result in ulcerations, bruises, or abrasions.
- **Tail chewing**—repetitive and excessive chewing of the tail that may result in alopecia, abrasions, or ulcerations.

Grooming behavior—out of context, repetitive self-grooming movements that may injure the animal but do not cause severe harm, are difficult or impossible to interrupt, and interfere with the animal's normal routine.
- **Lick granuloma**—licking in excess of normal grooming that results in areas of alopecia and abrasion.
- **Licking**—licking in excess of normal grooming that does not result in areas of alopecia.
- **Excessive grooming**—hair-pulling, licking, or chewing in excess of normal grooming that results in areas of alopecia.

Fears—behaviors resulting from the avoidance of triggers such as people, other animals, situations, or activities that the animal perceives as dangerous.
- **Fear of people**
  - **Fear of men**—reluctance to be near or in the vicinity of men.
  - **Fear of strangers**—reluctance to be near or in the vicinity of an unfamiliar person.
  - **Shyness**—preferring to be alone and not interacting with the owners.
- **Fear of animals**
  - **Antisocial behavior**—reluctance to be in the company of other members of the same species.
  - **Fear of insects**—reluctance to be near or in the vicinity of any type of insect.
  - **Fear of other dogs**—reluctance by a dog to be near or in the vicinity of other dogs.
- **Fear of situations**
  - **Agoraphobia**—fear of open spaces.
  - **Resistance to handling**—fear or reluctance to being picked up, held, or handled by a person.

House soiling—the release or deposition of feces or urine in an indoor location that is unacceptable to the owner.
- **Elimination**—normal amounts of urine or feces deposited outside of areas the owner considers acceptable and variable amount of urine released during periods of excitement or while the animal is in any type of submissive posture.
- **Excitement urination**—releasing small amounts of urine during periods of excitement.
- **Submissive urination**—releasing small amounts of urine while in any type of submissive posture.
- **Urination and defecation**—normal amounts of urine and feces deposited outside of areas the owner considers acceptable.
- **Defecation**—normal amounts of feces deposited outside of areas the owner considers acceptable.
- **Urination**—normal amounts of urine deposited outside of areas the owner considers acceptable.
- **Marking**—depositing less than normal amounts of urine or stool in socially or olfactory important locations.
- **Urine marking**—depositing less than normal amounts of urine on a vertical surface (spraying) or horizontal surface in socially or olfactory important locations, in response to social or olfactory stimuli, or both.

Miscellaneous—behaviors with criteria that do not fit well into any of the listed categories.
- **Cognitive dysfunction**—an age-related syndrome caused by degeneration in the brain and a decline in higher brain functions, causing a group of signs such as disorientation, changes in interactions with owners, and changes in sleep-wake cycles and elimination patterns.
- **Depression**—changes in appetite and sleep-wake cycle, often accompanied by social withdrawal.
- **Pseudocyesis**—the condition of false pregnancy in which hormonal changes consistent with pregnancy result in similar behavioral changes.
- **Psychogenic salivation**—salivating excessively because of stress and not because of a medical condition.

Appendix
Definitions of behavioral diagnoses for cats and dogs (continued).

Hyperesthesia syndrome—a poorly understood syndrome also known as twitchy cat disease, rolling skin disease, and feline neurodermatitis. Behaviors seen include rippling of skin, rolling on the floor, and self-directed mutilation; these behaviors are usually accompanied by vocalization.

Phobias—an extreme fear response that is excessive and disproportionate to any real or potential threat or situation perceived as threatening.
- **Hysteria when approached**—profound and extreme response to being approached by a person or another animal.
- **Noise phobia**—profound and extreme response to noise other than thunder, resulting in escape, avoidance, and anxiety behaviors.
- **Panic attack**—a profound response to a situation causing extreme anxiety.
- **Storm phobia**—profound escape, avoidance, or anxiety behaviors in response to thunderstorms and their manifestations (rain, noise, lightning, darkness, wind, and changes in barometric pressure and ozone).

Sexual behavior—sexual activity that is either excessive or inappropriately directed.
- **Masturbation**—self-manipulation of the genitals.
- **Mounting**—thrusting the pelvis against animate or inanimate objects.

Unruly behavior—behaviors resulting from control and obedience problems, including medical causes for inadequate control.
- **Attention-seeking behavior**—intrusive behavior initiated by the pet and continued until the pet has the owner's attention. The behavior may be active (such as jumping, vocalizing, pawing) or passive (such as staring, leaning against).
- **Destructive**—destroys household property by digging, scratching, or chewing in presence or absence of owner.
- **Difficult to control**—all situations in which the owner is unable to adequately control the dog, including jumping on people, running away, car chasing, and pulling while on lead.
- **Hyperactive**—unable to relax, high heart and respiratory rates, and high temperature at rest with little increase when exercised.
- **Hyperexcitable**—being overly stimulated or excited by situations, people, or objects.
- **Roaming**—leaving the property for extended periods before returning, usually for sex, food, or hunting prey.
- **Running away**—escaping from the property.
- **Scratching destructively**—use of the claws on a surface the owner considers undesirable.

Vocalization behavior—excessive annoying sounds emitted by the animal in play, excitement, greeting, social facilitation, and attention-seeking behavior, but excluding vocalizations secondary to serious behavioral problems such as separation anxiety, aggression and cognitive dysfunction.

Selected abstract for *JAVMA* readers from the American Journal of Veterinary Research

Influence of halothane, isoflurane, and sevoflurane on gastroesophageal reflux during anesthesia in dogs

Deborah V. Wilson et al

Objective—To determine whether maintenance of anesthesia with halothane or sevoflurane is associated with a lower incidence of gastroesophageal reflux (GER) than the use of isoflurane in dogs undergoing orthopedic surgery.

Animals—90 dogs.

Procedures—Dogs were evaluated during elective orthopedic surgery. Dogs with a history of vomiting or that had received any drugs that would alter gastrointestinal tract function were excluded from the study. The anesthetic protocol used was standardized to include administration of acepromazine maleate and morphine prior to induction of anesthesia with thiopental. Dogs were allocated to receive halothane, isoflurane, or sevoflurane to maintain anesthesia. A sensor-tipped catheter was placed to measure esophageal pH during anesthesia. Gastroesophageal reflux was defined as an esophageal pH < 4 or > 7.5.

Results—51 dogs had 1 or more episodes of acidic GER during anesthesia. Reflux was detected in 14 dogs receiving isoflurane, 19 dogs receiving halothane, and 18 dogs receiving sevoflurane. In dogs with GER, mean ± SD time from probe placement to onset of GER was 36 ± 65 minutes and esophageal pH remained < 4 for a mean of 64% of the measurement period. There was no significant association between GER and start of surgery or moving a dog on or off the surgery table. Dogs that developed GER soon after induction of anesthesia were more likely to regurgitate.

Conclusions and Clinical Relevance—Maintenance of anesthesia with any of the 3 commonly used inhalant agents is associated with a similar risk for development of GER in dogs. (*Am J Vet Res* 2006;67:1821–1825)

See the midmonth issues of *JAVMA* for the expanded table of contents for the *AJVR* or log on to avmajournals.avma.org for access to all the abstracts.

Behavioural effects of ovario-hysterectomy on bitches

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Journal of Small Animal Practice (1990) **31**, 595-598

ABSTRACT

A questionnaire about their dogs' behaviour was administered to the owners of 150 spayed bitches at the time of spaying and again six months later. It was also administered twice with the same time interval to a control group of 150 unspayed bitches, group matched for breed and age. Principal component analysis of the questionnaire responses yielded 13 factors. On two of these factors, 'indiscriminate appetite' and 'dominance aggression towards family members', the scores of the spayed bitches showed a significant increase compared with their controls. The spayed bitches most likely to show an increase in dominance aggression were puppies under one year, already showing some aggression.

INTRODUCTION

In bitches, the most frequently performed surgical operation is that of ovariohysterectomy, or spaying. Although it is sometimes performed for medical reasons, its most usual purpose is the avoidance of pregnancy and the inconveniences of a bitch in oestrus. It is occasionally undertaken as a treatment for a behavioural problem. It is sometimes stated that spaying affects temperament adversely (for example that spayed bitches 'lack personality' or are 'frankly neurotic' (Jones and Joshua 1982)). It has been observed clinically (Voith and Borchelt 1982, O'Farrell 1986) that owners of bitches presenting with problems of aggression frequently report an exacerbation after spaying. However, there are no objective and controlled studies in this area. The aim of the present study was to fill this gap.

MATERIALS AND METHODS

The owners of 150 bitches were interviewed at the time that the bitch was spayed and again six months later. They were an unselected sample, being the first 150 owners contacted through veterinary practices who were available for interview. These formed the experimental group. The control group was composed of 150 unspayed bitches: their owners were also interviewed twice with an interval of six months. The controls were matched for breed with the bitches in the experimental group and the groups were matched for age. No dog was included in the study which was less than four months old at initial interview or which had been acquired less than one month previously.

Questionnaire

The interview took the form of a questionnaire with 60 items. Twenty of the items were concerned with basic information about the dog and its circumstances: age, age when acquired, number of dogs and people in the household, number of pregnancies, etc. The rest of the questionnaire was concerned with the dog's behaviour over the previous month. The following areas were covered: aggression (to owners, visitors, other dogs), fears, activity level, excitability, destructive chewing, reactions to separation from owner, behaviour in the car, roaming, feeding, urination and defecation and scavenging. Most of the questions were phrased in such a way that the replies were in the form of an estimated absolute or relative frequency of the behaviour.

RESULTS AND DISCUSSION

To simplify the results of the responses to the 40 behavioural items, the correlations between the items were subject to principal component analysis. The results are shown in Table 1.

Table 1. Principal component analysis of questionnaire items (Varimax rotation)

	Factor loadings
Factor 1. Protective aggression (9·8% of variance)	
Threatens people outside family	0·76
Barks, growls when owner opens door to someone	0·68
Gets excited when owner opens door to someone	0·60
Factor 2. Aggression towards other dogs (7·2% of variance)	
Growls at other dogs	0·85
Growls at dogs outside the household	0·83
Factor 3. Urination or defecation indoors (5·2% of variance)	
Urinates in house	0·83
Defecates in house	0·78
Factor 4. Destructive behaviour (4·8% of variance)	
Destructive when left alone	0·88
Destructive chewing generally	0·81
Factor 5. Phobias (4·4% of variance)	
Afraid of visitors	0·73
Afraid of specific kind of person (eg, men)	0·76
Afraid of things (eg, vacuum cleaner)	0·57
Factor 6. Dominance aggression towards family members (4·3% of variance)	
Threatens if disturbed when resting	0·78
Threatens family members	0·72
Threatens when groomed	0·50
Threatens when something taken away (eg, food)	0·35
Factor 7. Excitement in car (3·6% of variance)	
Sits quietly in car	−0·85
Jumps about or barks in car	0·81
Factor 8. Indiscriminate appetite (3·5% of variance)	
Eats meals quickly	0·83
Eats any commercial dog food	0·83
Eats rubbish, carrion, etc	0·36
Factor 9. Dislike of separation from owner (3·3% of variance)	
Follows owner to door on departure	0·74
Looks miserable when owner leaves	0·63
Takes no notice when owner leaves	−0·55
Factor 10. Territorial urination (3·1% of variance)	
Adopts non-squatting posture when urinating	0·74
Urinates frequently on walks	0·72
Factor 11. Activity level in the house (2·8% of variance)	
Moves around constantly	0·74
Reacts to noises	0·48
Follows owner around house	0·38
Factor 12. Perverse appetite (2·7% of variance)	
Eats dog faeces	0·87
Eats rubbish, carrion, etc	0·57
Factor 13. Reactivity (2·6% of variance)	
Reacts to noises	0·72
Threatens when groomed	0·45
Barks when left	0·43

Table 2. Differences between experimental and control groups at first interview

Spayed group	
1 Was acquired at older age	P<0·001
2 Had fewer administrations of synthetic progestogen	P<0·01
3 Had fewer dogs in household	P<0·0001
4 Reacted less to separation (factor 9)	P<0·01
5 Jumped about less in car	P<0·01
6 Roamed more from house	P<0·02

Table 3. Change in factor scores in unspayed group between first and second interview

Factor	Change
1 Protective aggression	+
2 Aggression towards other dogs	+
3 Urination or defecation in the house	− (P = 0·002)
4 Destructive behaviour	−
5 Phobias	−
6 Dominance aggression towards family members	−
7 Excitement in car	− (P < 0·05)
8 Indiscriminate appetite	− (P < 0·01)
9 Reaction to separation from owner	−
10 Territorial urination	+ (P < 0·01)
11 Activity level in the house	−
12 Perverse appetite	−
13 Reactivity to stimuli	−

Where changes are significant, significance level is shown (Wilcoxon test)

For each interview, a score on each factor was calculated by summing the score on the relevant items, weighted by their factor loadings. In analysing the results, for the most part, these factor scores were used, rather than the scores on the individual items.

Next, the results were examined to see if there were any significant differences between the spayed and unspayed groups at initial interview. Any significant differences between the groups would mean that groups were not matched on those variables. The mean age of the experimental group was 33·47 months (SD 33·95). The mean age of the control group was 33·29 months (SD 30·52). These ages were not significantly different: the groups, therefore, had been successfully matched for age. There were, however, significant differences between the groups on some variables: these are shown in Table 2. The relevance of these differences is discussed later.

The factor scores on first and second interview for the unspayed bitches were then compared (Wilcoxon test for matched pairs) to determine what changes in behaviour had occurred due only to the passage of time. The changes in the factor scores are shown in Table 3. It can be seen from this table that significant decreases occurred in urination and defecation in the house, excitement in the car and indiscriminate

Table 4. Change in factor scores in unspayed group between first and second interview by age

Factor	Change		
	11 months and under	12-24 months	25 months and over
1 Protective aggression	+	+	−
2 Aggression towards other dogs	+	+	−
3 Urination or defecation in the house	− (P = 0·003)	−	−
4 Destructive behaviour	−	−	+
5 Phobias	+	+	− (P = 0·002)
6 Dominance aggression towards family members	−	−	−
7 Excitement in car	− (P = 0·02)	−	−
8 Indiscriminate appetite	− (P = 0·01)	−	−
9 Reaction to separation from owner	+	−	−
10 Territorial urination	+ (P = 0·005)	+	+
11 Activity level in the house	−	+	−
12 Perverse appetite	−	+	−
13 Reactivity to stimuli	−	+	−

Where changes are significant, significance level is shown (Wilcoxon test)

appetite: a significant increase occurred in territorial aggression. The unspayed group was then divided into three age groups: 11 months and under (puppies), one to two years and over two years. The changes occurring in these groups over the six months were examined. These are shown in Table 4. It can be seen that where significant changes occurred in the group as a whole, these were due to changes in the puppy group. These changes are not surprising: they are the changes one would expect in puppies as they mature. The finding, however, is reassuring, as it confirms the validity of the questionnaire. It is interesting that fears do not follow the same pattern: they do not decrease until the bitch is over two years old.

The changes in the spayed group from first to second interview were then calculated and the changes compared with the changes in the unspayed group (Wilcoxon test). The comparison was also made with the puppies excluded, in case changes in the puppy group were masking changes due to spaying. The factors for which the changes in the spayed and unspayed group differed significantly are shown in Table 5.

The first question to be considered is whether these differences are due to spaying or whether they might be accounted for by any of the differences between the two groups at initial interview. It seems unlikely that the difference on factor 6 (dominance aggression) or on factor 8 (indiscriminate appetite) could be accounted for by any of the initial differences. However, in the case of factor 7 (excitement in the car) the items which loaded on this factor were 'does not sit quietly in the car' and 'jumps about in the car'. On examining the changes on these two items, it was found that changes in the 'jump about' item were solely responsible for the significant difference in the changes between the groups on factor 8. The initial scores of the two groups on the 'jump about' item were significantly different (Table 2): it cannot be concluded, therefore, that spaying caused an increase in excitement.

With regard to factor 8 (indiscriminate appetite), it seems safe to conclude that the relative increase in the experimental group when puppies were excluded was due to the effects of spaying. Presumably this behavioural change

Table 5. Change in factor scores between first and second interview: significant differences between experimental and control groups

Factor	
6 Dominance aggression towards family members	
Spayed group increase	
Unspayed group decrease	
	P<0·05
7 Excitement in car	
Spayed group increase	
Unspayed group decrease	
	P<0·05
8 Indiscriminate appetite (puppies excluded)	
Spayed group increase	
Unspayed group decrease	
	P<0·05

Table 6. Changes in dominance aggression by age

Age	Aggression increases	Aggression stays the same	Aggression decreases	Total
11 months or less	S = 13 U = 4	S = 28 U = 31	S = 4 U = 6	S = 45 U = 41
12-24 months	S = 6 U = 6	S = 31 U = 26	S = 5 U = 7	S = 42 U = 39
2 years +	S = 14 U = 11	S = 38 U = 43	S = 11 U = 16	S = 63 U = 70
Total	S = 33 U = 21	S = 97 U = 100	S = 20 U = 29	

S Number of bitches in spayed group
U Number of bitches in unspayed group

Table 7. Changes in dominance aggression by initial aggression score

Initial Aggression	Aggression increases	Aggression stays the same	Aggression decreases	Total
Some aggression	S = 16 U = 8	S = 7 U = 5	S = 20 U = 29	S = 43 U = 42
No aggression	S = 17 U = 13	S = 90 U = 95	—	S = 107 U = 108
Total	S = 33 U = 21	S = 97 U = 100	S = 20 U = 29	

S Number of bitches in spayed group
U Number of bitches in unspayed group

Table 8. Changes in dominance aggression by age and initial aggression

	Aggression increases	Aggression stays the same	Aggression decreases	Total
Bitch under 12 months showing some initial aggression	S = 6 U = 1	S = 2 U = 0	S = 4 U = 6	12 7
Bitch over 12 months showing no initial aggression	S = 10 U = 10	S = 64 U = 64	—	74 74

sometimes results in the weight gain which is often cited as a possible side-effect of spaying.

Similarly, it seems safe to attribute the change in factor 6 (dominance aggression towards family members) to spaying. The results were examined more closely in an attempt to discover which bitches are most at risk of developing increased aggression following spaying. Table 6 shows the changes occurring in bitches spayed at different ages. It can be seen that although there is no clear trend with increasing age, the greatest difference between experimental and control group occurs in the youngest age group. Table 7 shows a comparison between bitches showing some aggression at initial interview and those showing none. It can be seen that there is a greater risk of aggression increasing in those already showing some aggression. Combining the variables age and initial aggression, Table 8 compares puppies under one year old already showing some aggression with dogs over one year showing none. If a puppy showing some aggression is spayed, there is a 50/50 chance that her aggression will increase. If she is not spayed, the chances are 6 to 1 that her aggression will decrease. On the other hand, if an adult bitch showing no aggression is spayed, this does not increase at all the chances that she will subsequently show some aggression: these are 6 to 1 in either case.

CONCLUSIONS

There is no evidence that spaying has beneficial effects on behaviour (excluding, of course, behaviour directly connected with oestrus).

The operation should not be undertaken as a treatment for behavioural problems.

Spaying is accompanied by the risk of certain behavioural changes. There is a risk of increase in indiscriminate appetite. More importantly, there is a risk of increase in dominance aggression towards family members. This risk is greatest in puppies under one year already showing some aggression. For these, some alternative method of controlling oestrus (eg, a synthetic progestogen or a surgical procedure which does not remove all ovarian tissue) might be preferable. (Unfortunately, the figures do not, of course, indicate whether the risk diminishes for these dogs as they get older). On the other hand, there seems no risk of increased aggression resulting from spaying for older dogs not showing any aggression. In addition the study showed no adverse effects on other kinds of behaviour.

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Effects of ovariohysterectomy on reactivity in German Shepherd dogs

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Abstract

This study investigated the effects of ovariohysterectomy on reactivity of German Shepherd dogs. Fourteen healthy dogs ranging in age from 5 to 10 months were assigned to an ovariohysterectomy or a sexually intact group. Their behaviours were digitally video recorded 4–5 months after treatment and analysed for treatment effects on reactivity. Responses to the approach of an unfamiliar human leading an unknown dog were assigned the following reactivity scores: severe reactivity, 3; moderate reactivity, 2; defensive or mild reactivity, 1; attentive or no reactivity, 0. Median reactivity scores in response to the approach of an unfamiliar human walking with an unknown dog were calculated for each observation period.

Dogs in the ovariohysterectomized group showed more reactivity, and median reactivity scores were higher in the ovariohysterectomy group compared with those of the sexually intact group. Ovariohysterectomy of 5–10 month old German Shepherd bitches specifically, and perhaps bitches of any breed generally, may induce an increase in reactivity. Practitioners may benefit from recognizing that a range of behavioural changes may occur post-ovariohysterectomy.
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Keywords: Aggression; Behaviour; Dog; Ovariohysterectomy; Reactivity

1. Introduction

Ovariohysterectomy is one of the most frequently performed surgical operations in dogs. The usual recommendation is to perform the surgery when a bitch is between 5 and 8 months old and after the first oestrus (Jackson, 1984; Johnston, 1993; Salmeri et al., 1991; Stone et al., 1993).

The most common reason for performing an ovariohysterectomy is to prevent unwanted pregnancy (Salmeri et al., 1991) but other reasons include prevention and treatment of pyometra, metritis, neoplasia, cysts, trauma, uterine torsion and subinvolution of placental sites (Cotchin, 1961; Dow, 1958; Durfee, 1968; Fidler et al., 1966; Fingland, 1998; Hedlund, 2002; Jergens et al., 1987; Sandholm et al., 1975; Stone et al., 1993). Although ovariohysterectomy has been performed for many of the reasons given above, the side effects of the operation, particularly any changes in behaviour, have been quantified in only few studies (Hardie et al., 1997; O' Farrell and Peachey, 1990).

Houpt et al. (1979) reported that ovariohysterectomized bitches gained more weight than sham-operated controls and food intake also was significantly greater. On the basis of a survey of owners, O' Farrell and Peachey (1990) noted that spaying was accompanied by a risk of increased indiscriminate appetite and by aggression towards family members but only if the puppies already exhibited some aggression at less than one year

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of age. Salmeri et al. (1991) found that ovariohysterectomized bitches showed more general activity than a sexually intact group, and Thrusfield (1985) reported that urinary incontinence occasionally followed ovariohysterectomy.

A dog's 'reactivity' can be inferred by visual signals, from the ears, mouth, facial expression, tail, the hair on shoulders and rump, overall body position and posture (Abrantes, 1997; Beaver, 1999; Houpt, 1998; Landsberg et al., 2003; Overall, 1997; Schaffer, 1993; Voith and Borchelt, 1996). In order to investigate behavioural changes after ovariohysterectomy we exposed the dogs in the present study to a strong social stimulus: a stranger and a strange dog approaching the front of the dog's kennel. We observed the dogs' behaviour, and the visual, auditory signals shown. On the basis of these observations, we evaluated the effects of ovariohysterectomy on canine behaviour.

2. Materials and methods

2.1. Experimental animals

Fourteen healthy German Shepherd (GSD) bitches at the Korean Air Force Dog Training Center were studied. Their ages were between 5 and 10 months (mean ± SD, 6.5 ± 1.8) at the time of surgery and between 10 and 15 months at the time of behavioural testing. Dogs were housed in 180 × 240 cm wire mesh kennels with 250 cm walls. Each kennel contained a 180 × 60 × 140 cm dog house.

The animals were handled according to the Laboratory Animal Control Guidelines of Gyeongsang National University, which are based on the *Guide for the Care and Use of Laboratory Animals* of the US National Institutes of Health (1996).

2.2. Experimental design and surgery protocol

The dogs were assigned randomly to either the ovariohysterectomy (OVH) or to the sexually intact group (SIG).

OVH dogs were premedicated with glycopyrrolate (0.01 mg/kg, IM), acepromazine (0.02–0.05 mg/kg, IM), butorphanol (0.02–0.04 mg/kg, IM) or oxymorphone (0.05 mg/kg, IM). General anaesthesia was induced by administration of thiopental sodium (10–12 mg/kg, IV) and anaesthesia was maintained with isoflurane (1–2.5%) during OVH (surgery group). SIG dogs were anaesthetized as above and then allowed to recover from the anaesthesia.

During the first 18–24 h after surgery, IM injections of either oxymorphone (0.05 mg/kg) or butorphanol (0.02–0.04 mg/kg) were administered every 6 h for management of pain. To control for genetic and early environmental influences, littermates were assigned equally to both groups.

The responses of the bitches to the approach of a unfamiliar human with a dog unknown to the test dog to within 1 m of the dog's kennel were recorded using a Digital Palmcorder four and five months after surgery when the dogs were 10–15 months old. The 14 dogs were observed twice one week apart at 4 months and twice one week apart at 5 months making a total of 56 observations. Only the focal dog remained in a run; the other dogs were confined indoors.

The unfamiliar human and dog stood in front of the kennel and the observations ended when the dog calmed down. Behaviours were analysed for 2–3 min during each observation.

2.3. Behaviour analysis

A single observer performed all analyses of the videos.

Parameters observed were ear, eye and lip-positions, tooth exposure and posture. Any vocalization was also recorded.

On the basis of previous descriptions (Abrantes, 1997; Beaver, 1999; Houpt, 1998; Landsberg et al., 2003; Overall, 1997; Reisner, 2003; Schaffer, 1993; Voith and Borchelt, 1996), all behaviour used for analysis was scored by an observer blind to the dog's reproductive condition. Individual reactivity scores in response to the approach of a stranger with a strange dog (the stimulus to reactivity) were determined, and a median reactivity score was calculated for each observation time (Table 1).

If a dog reacted with barking and growling, snarling, lips lifting or curling, head up, ears forward, staring, widely opened eyes and was lunging and jumping it was given a score of 3 (Fig. 1). Ifone to three of these actions were not exhibited the dog was given a score of 2 (Fig. 2). If four or more were not exhibited the dog was given a score of 1 (Fig. 3). If the dog did not respond at all it received a 0 score (Fig. 4).

Table 1
Evaluation and grading of reactivity

Grade	Description of body expression and vocalization
3	Vocalization: bark or growling, movement: lunging or jumping, snapping, head: up, ear: forward, eye: large palpebral fissure staring, lip: lifting or curling
2	Body expression and vocalization were changed by ⩽3 items, being compared with grade 3
1	Body expression and vocalization were changed by ⩾4 items, being compared with grade 3
0	No response or attentive

Fig. 1. The posture of grade 3 reactivity. Dog barks and shows growling, jumping, snapping, head up, ear forward, large palpebral fissure staring and lip curling.

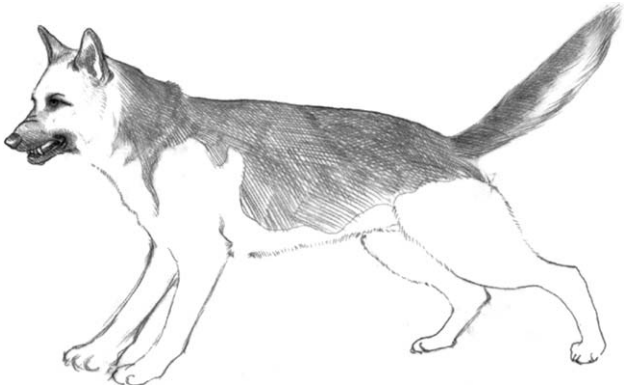

Fig. 2. The posture of grade 2 reactivity. Dog shows growling, snapping, ears forward, large palpebral fissure, staring, lip curling and tail up.

2.4. Statistical analysis

The behavioural effect of OVH was evaluated by comparing the scores of the two groups. The non-parametric repeated measures analysis of variance and Mann–Whitney *U*-test were used for comparisons between the OVH and sexually intact groups. Wilcoxon matched-pairs signed-ranks test was used to make comparison within groups between the observation times. All statistical tests were performed by use of computer software SPSS 9.

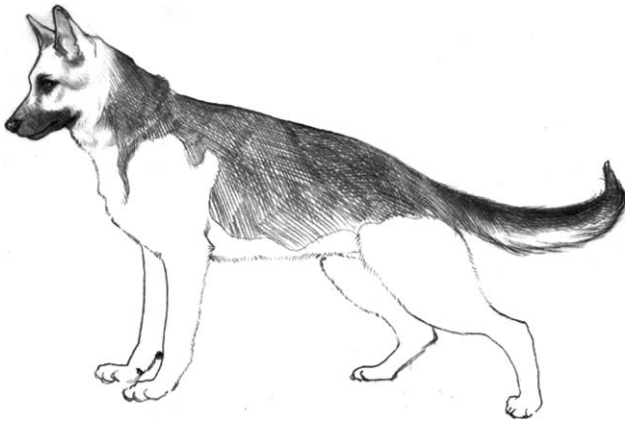

Fig. 3. The posture of grade 1 reactivity. Dog shows ears forward, large palpebral fissure staring and tail swing.

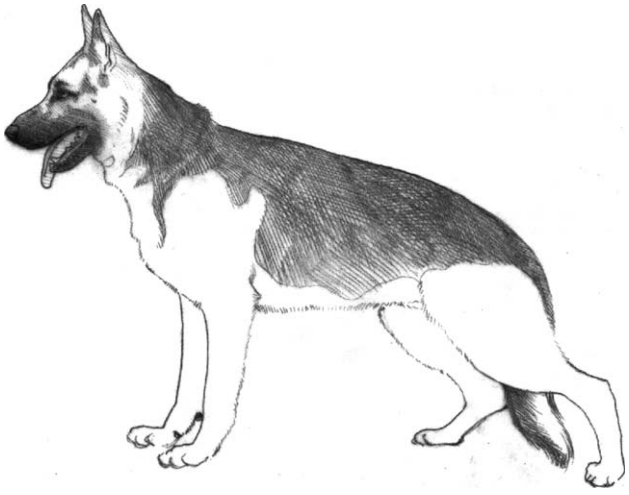

Fig. 4. The posture of grade 0 reactivity. Dog shows ears forward and a relaxed tail.

3. Results

Dogs in the OVH group showed increased reactivity based on facial expression and activities. Median reactivity scores were higher in the OVH group compared to those of the sexually intact group ($P < 0.05$) (Table 2). Median reactivity scores of the OVH group decreased significantly from 3 during the first observation to 1.1 during the fourth observation ($P < 0.001$). Median reactivity scores of the SIG group decreased from 1 at first observation time to 0.4 during the fourth observation ($P = 0.218$).

Of the 56 observations (4×14 dogs), head up was observed 43 times – 25 OVH and 18 SIG. The ears were forward 32 times – 25 OVH and 7 SIG. Staring with widely opened eyes was observed 22 times but only in the OVH group. The commissures of the lips were drawn forward 17 times and all in the OVH group.

Table 2
Individual reactivity scores in response to the approach of a stranger with a strange dog (the stimulus to reactivity)

Observation time	Group													
	OVH (n = 7)							SIG (n = 7)						
Dog ID:	A	B	C	D	E	F	G	H	I	J	K	L	M	N
4th month														
1st week	3	3	2	2	2	2	1	1	1	1	1	1	1	0
2nd week	3	3	2	2	2	2	1	1	1	1	1	1	1	0
5th month														
1st week	3	3	2	2	2	1	1	1	1	1	1	1	1	0
2nd week	3	2	2	2	2	1	1	1	1	1	1	1	1	0

Note: OVH, ovariohysterectomy group; SIG, sexually intact group.

Table 3
Items and frequencies of observed behaviours

Items	Behaviour	SIG	OVH	Items	Behaviour	SIG	OVH
Head	Up	18	25	Tail	High, wagging rapidly	5	3
	Down	10	0		High, wagging slowly	2	3
Ears	Forward	7	25		Horizontal, wagging rapidly	3	12
	Flanked	16	0		Horizontal, wagging slowly	3	10
	Flattened	5	3		Down	8	0
Eyes	Big, staring	0	22		Down, wagging rapidly	2	0
	Averted	7	3		Down, wagging slowly	5	0
	Moved	11	0	Posture	Shifted to front	6	25
	In nature	10	3		Shifted to middle	16	3
					Shifted back	6	0
Lips	Drawn forward	0	17	Vocalization (sum of call numbers)	Bark	311	1314
	Drawn back	10	6		Bark and growl		105
	In nature	18	5		Bark and whine	533	
Movements	Jump	5	5		Bark, growl, and whine		45
	Lunge	0	2	Teeth	No	19	5
	Jump and lunge	0	10		Incisor	0	6
	Retreat	8	0		Canine	1	9
	Sit	2	0		Premolar	7	7
	Circle	2	0		Molar	1	1
	Come and go	10	10				
	No movement	1	1				

Note: SIG, sexually intact group; OVH, ovariohysterectomy group.

Raised and a rapidly wagged tail was observed 8 times, 3 OVH and 5 SIG. A neutral posture – leaning neither forwards nor backwards was observed 19 times, 3 OVH and 16 SIG. Leaning back was observed 6 times, all by SIG (Table 3).

4. Discussion

The study was carried out to investigate the effects of OVH on reactivity in German Shepherd bitches 4 and 5 months after surgery. The results revealed that reactivity was increased in the OVH dogs in comparison to the intact group. It is unlikely that post-operative pain or side effects of analgesics was responsible for any of the increased reactivity due to the time that had elapsed since surgery.

Although this is the first prospective study of the effects of spaying on reactivity, there have been two retrospective studies indicating an increase in reactivity after surgery. The risk of post OVH reactivity is higher if the bitches had already exhibited reactivity before their first birthday (O' Farrell and Peachey, 1990). A recent study indicated no difference in aggressiveness between bitches ovariohysterectomized before or after they had reached 5.5 months of age (Spain et al., 2004). Other less serious changes after OVH include an increase in activity and an increase in food intake, which, combined with a decreased metabolic rate, leads to an increase in body weight and urinary incontinence (which may be due to oestrogen deficiency or to adhesions or granulomas of the stump that interfere with the bladder sphincter mechanism) (Hardie et al., 1997; Houpt et al., 1979; Kyles et al., 1996; Salmeri et al., 1991).

In the present study, overall body expression and specific facial expressions were used to determine the level of reactivity. More spayed bitches than intact bitches exhibited wide open staring eyes. These results are similar to broad findings cited for self-confident or offensively aggressive dogs (Abrantes, 1997; Beaver, 1999; Houpt, 1998; Landsberg et al., 2003; Overall, 1997; Reisner, 2003; Schaffer, 1993; Voith and Borchelt, 1996). In our study, we found that more of spayed than intact GSD bitches had erect ears, although the erect ear could be simply an expression of an attentive or solicitous dog.

In previous descriptions (Abrantes, 1997; Beaver, 1999; Houpt, 1998; Landsberg et al., 2003; Overall, 1997; Reisner, 2003; Schaffer, 1993; Voith and Borchelt, 1996), shifting weight to the front was considered to be offensively aggressive, shifting the weight back to be withdrawal due to fear. Although shifting weight to the front feet could be ambivalent, we considered it as offensive reactivity if the dog showed other offensive behaviour.

Lifted lips were considered to be reactivity and relaxed lips as non-reactivity. If the commissures of the lips were drawn forward the dog was considered to be offensively reactive, but if they were drawn back she was considered to be defensively reactive. Based on overall body expression, OVH bitches showed more offensive reactivity than sexually intact dogs. Median scores decreased during the two months of observation time. The dogs probably had habituated to the stimuli eliciting behaviour.

Dogs communicate with various signals as human do. Common visual communication signals of dogs are ear-position, lip-position, facial expression, tail carriage, piloerection and overall body posture. These communications are different according to the dog's interpretation of and response to those of other individual in the environment. Relaxed dogs will show ears and tail that are down and will stand in a relaxed posture, but reactive dogs show erect ears, head and tail up and staring eyes. In this study, we observed head posture, eyes and ear position with the overall body posture. The results indicated that the postures of the dogs in OVH group presented with more offensive reactivity than those of the sexually intact group. Because the German Shepherd breed in general, and these military dogs in particular, have been selected for aggression and guard work, studies should be undertaken to measure the effect of ovariohysterectomy on the behaviour of bitches of other breeds.

Reactivity was induced by the approach of a stranger with a strange dog to the front of the study animal's own kennel, and dogs ovariohysterectomized between 5 and 10 months of age exhibited an increase in intensity of reactivity as measured by visual signals. Whether either earlier or post pubertal OVH would have had similar effects is unknown, but veterinary practitioners should inform owners that a bitch may become more reactive after spaying either because they have lost the calming effects of progesterone or because elevated gonadotropins stimulate release of adrenal androgens.

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