

National survey of owner-directed aggression in English Springer Spaniels

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Objective—To determine prevalence of owner-directed aggression and identify associated environmental and genetic factors in English Springer Spaniels.

Design—Prevalence survey.

Animals—1,053 adult English Springer Spaniels.

Procedure—A mail survey was sent to 2,400 randomly selected owners of adult American Kennel Club-registered English Springer Spaniels. Dogs with a history of aggression to family members and familiar humans were compared with dogs without such a history.

Results—1,053 questionnaires (56.1% of the 1,877 delivered) were completed. A history of owner-directed growling or more intense aggression was reported in 510 (48.4%) dogs. Two hundred seventy-seven (26.3%) dogs had bitten a human in the past; 65.2% of bites were directed at familiar (owner or nonowner) adults and children. Variables associated with owner-directed aggression included sex of dog (male), neuter status (neutered, regardless of sex), show or bench lines, age > 4 years, aggression to unfamiliar adults and children, acquisition from a hobby breeder, less responsiveness to obedience cues, and a specific kennel and 1 popular sire from that kennel in a 4-generation pedigree.

Conclusions and Clinical Relevance—Owner-directed aggression in adult English Springer Spaniels was associated with a number of environmental, sex-related, and inherited factors. To reduce the risk of aggression, prospective owners might seek a female, hunting-type English Springer Spaniel from an experienced breeder. However, because risk factors are broad and varied, there are limitations to the extent to which behavior can be predicted and further study is needed of the inheritance of aggression in this breed. (*J Am Vet Med Assoc* 2005;227:1594–1603)

Aggressive behavior is the primary problem for which dog owners seek help from behavioral specialists.¹⁻³ In most instances, the complaint is aggression directed to owners or other familiar persons.⁴ Aggression to owners may occur for a number of rea-

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sons and is not, in itself, a clinical diagnosis. A diagnosis or classification of owner-directed aggression has historically been associated with dominance, fear, resource-guarding (eg, food), pain, punishment, or aggressive play.^{2,5} Regardless of the presumed motivation, more than 1 million dog bites are reported annually in the United States.⁶⁻⁸ This figure is considered to be an underestimate of actual bites.^{7,9} Contrary to the expectation that bites are usually inflicted by free-roaming dogs, dogs owned by the family, neighbors, or friends of the victim inflict most bites.⁹⁻¹¹ In a study⁷ of dog bites in a large city, one quarter of victims had been interacting with the dog in a friendly manner (rather than intentionally provoking, teasing, or abusing the dog) when they were bitten.

In contrast to problems reported by owners of dogs referred to specialists, in which aggression predominates, behavior problems listed by owners of dogs that have not been referred are variable. In 1 survey,¹² owners did not include aggression as a major complaint. When aggression was reported, owners complained of either territorial¹² or unspecified aggression.¹³ The absence of reports of aggression toward familiar humans may reflect the design of the questionnaire, which also may not have distinguished adequately between owner-directed, dominance-related, and other classifications of aggression, including play-related biting of family members.¹⁴ When aggression was specifically addressed in a telephone survey of veterinary clientele, 41% reported that their dog had growled at a member of the household and 15.6% had bitten a member of the household; however, aggression in this instance included play-related growling and biting.¹⁵

English Springer Spaniels are the purebred dog most frequently referred to behavioral specialists because of aggressive behavior in at least 2 studies^{4,16} and in numbers higher than expected relative to breed popularity.¹⁷ In the experience of 2 of the authors (IRR and KAH), 1 particular midwestern breeding kennel and at least 1 of its stud dogs have frequently been present in the pedigrees of English Springer Spaniels referred for treatment of aggressive behavior. A consistent association has not been reported, however.

The objectives of the study reported here were to determine the prevalence of owner-directed aggression in the general, nonreferred population of English Springer Spaniels and identify the environmental and genetic factors associated with this behavior problem.

Materials and Methods

Dogs between the ages of 3 and 5 years were selected to identify aggressive behavior at or past the age of social maturity (1 to 3 years old). With the permission of the English Springer Spaniel Field Trial Association, dogs were selected from the American Kennel Club (AKC) database of approxi-

mately 64,800 English Springer Spaniels of those ages by selecting every 27th registration number, along with the names and addresses of owners, for a mail survey. The survey was targeted to a sample of 2,000 dogs; 2,400 were obtained to allow for owners who could not be contacted because they had moved in the 3 to 5 years since their dogs were registered with the AKC. Respondents were told that results would remain anonymous.

Questionnaires were designed via the protocol for mail surveys by Dillman.¹⁸ Each questionnaire was assigned a number, by which it and the reply envelope were identified, which assured anonymity during tabulation, analysis, and publication. A cover letter explained the purpose of the survey and specifically referred to the dog whose registration number had been provided by the AKC. We requested that the respondent be the primary caretaker of the dog. If the dog was unavailable, or if there were more than 1 adult English Springer Spaniel in the home, owners were asked to refer to the adult English Springer Spaniel dog whose name was closest to the start of the alphabet (to avoid possible bias in which dog was chosen). After completion of the survey, 4-generation pedigrees were obtained directly from the AKC for each dog in the survey. Pedigree matching was confirmed between the AKC-registered dog and the dog for which the survey was completed. If confirmation was not possible, the pedigree was not included in the analysis. Anonymity was assured for individual dogs and their owners as well as for kennels recorded on pedigree papers. Cover letters and questionnaires were mailed with stamped reply envelopes. After 3 weeks, nonresponders received a postcard reminder, followed by second and third mailings of the survey and follow-up cover letters. The first mailing included 2,000 owners; an additional 400 questionnaires were subsequently mailed after receipt of nonforwarding notices for approximately 400 owners who had relocated.

Questions were either open-ended or multiple choice. There were several opportunities for brief written answers, and owners were encouraged to elaborate on their responses in the questionnaire margins or to include letters with additional information if they wished.

Aggressive behavior was addressed in 2 ways. First, an aggression screen listed historical circumstances in which aggression to owners might have been provoked. The major outcome variable, owner-directed aggression, was defined as any evidence of growling, snapping, or biting toward the owner in at least one of the following situation categories: hug, pet dog on head, pet dog on back, kiss, lift, stare at dog, remove dog food, remove special food or bone, remove objects, scold, threaten to punish physically, punish physically, administer leash correction, push dog onto back, command down, push dog off furniture, nudge dog on bed or couch, startle or disturb while sleeping, groom or brush dog, trim nails, bathe, step over dog, bend over dog, and put on or take off leash. Owners were asked to record the most severe reaction, historically, that they had seen in their dogs in response to the listed provocations. Respondents could select no aggression; barking; growling, lifting the lip, or both; snapping (no contact); biting (contact); and not applicable. Because of its ambiguous importance, the variable barking was not included in the definition of owner-directed aggression. In addition to circumstances selected to identify owner-directed aggression, the questionnaire included reactions to the approach of an unfamiliar adult, children (familiar or unfamiliar) up to 7 years old, and another dog.

In a second measure of aggressive behavior toward a wider range of human targets, owners were asked whether their dog had ever bitten a human and who was bitten. Targets of bites were listed as follows: unfamiliar adult in house, yard, or car; unfamiliar adult somewhere else; unfamiliar child in house, yard, or car; unfamiliar child somewhere else; familiar adult but not household member; familiar child but not household member; adult household member; and child household member.

We were particularly interested in determining whether 1 specific kennel or line and 2 popular sires from that kennel were associated with aggressive behavior. Each dog's 4-generation pedigree was examined for kennel and sires (when we were able to confirm a match between the dog in the survey and the AKC-generated pedigree), and both the number of representations per pedigree and yes-no variables for their presence in each pedigree were tested against aggression. For the purpose of anonymity, the kennel was represented as kennel X and the sires as sire Y and sire Z.

Disposition was a variable that was analyzed from information obtained indirectly from the questionnaire. Disposition referred to the dog's present status (ie, alive and in the home, surrendered or sold because of aggressive behavior, surrendered or sold because of other reasons, euthanized because of aggressive behavior, or euthanized or died because of other reasons).

Responsiveness to obedience cues was scored as always (100% of time), usually (75% to 99%), sometimes (25% to 74%), rarely (1% to 24%), never (0%), or not applicable. Obedience cues included sit; sit-stay 1 minute, owner nearby; down; down-stay 3 minutes, owner nearby; come, indoors; come, outdoors; and heel.

Statistical analyses—Data were summarized by use of frequencies and percentages for categorical data and means and ranges for continuous data. To determine whether factors were associated with owner-directed aggression, χ^2 or Fisher exact tests (2×2 tables) were performed for categorical data and *t* tests for continuous data. In addition, a multiple logistic regression model was used to identify factors that were independently associated with owner-directed aggression. Factors that were significant at $P < 0.1$ on initial univariate analysis were tested for inclusion in the model. Where applicable, data are reported as **odds ratios (ORs)** with 95% **confidence intervals (CIs)**. Significance was defined as $P < 0.05$. All analyses were performed with statistical software.^a

Results

Five hundred twenty-three questionnaires could either not be delivered because of lack of a forwarding address or were not completed for various reasons (eg, the dog had been sold as a puppy). Of the 1,877 questionnaires presumed delivered, 1,062 (57%) were returned; 1,053 (56% of delivered questionnaires) were adequately completed. There were 494 (47%) males of which 327 (31%) were sexually intact and 559 (53%) females of which 219 (21%) were sexually intact. The mean age was 4.75 years (range, 0.5 to 14 years). Two hundred seventy-two (26%) owners identified their dogs as bench or show type, 473 (45%) as field type, and 308 (29%) did not know what type they owned. Most respondents ($n = 458$ [44%]) first learned of the availability of their puppy or dog through a newspaper advertisement. Other initial sources included word of mouth ($n = 253$ [24%]), a friend or relative (14%), calling breeders (10%), seeing the puppy in a pet store (4%), or receiving the puppy or dog as a gift (2%). Sixty percent of owners obtained their dog through a private home or hobby breeder (Figure 1). More than 1 reason for acquiring each dog could be indicated and included pet ($n = 912$), hunting (359), breeding (90), protection (67), conformation (showing in breed; 55), and obedience competition (24).

The aggression screen revealed that dogs were aggressive toward their owners in a variety of contexts (Table 1). There was a history of owner-directed growl-

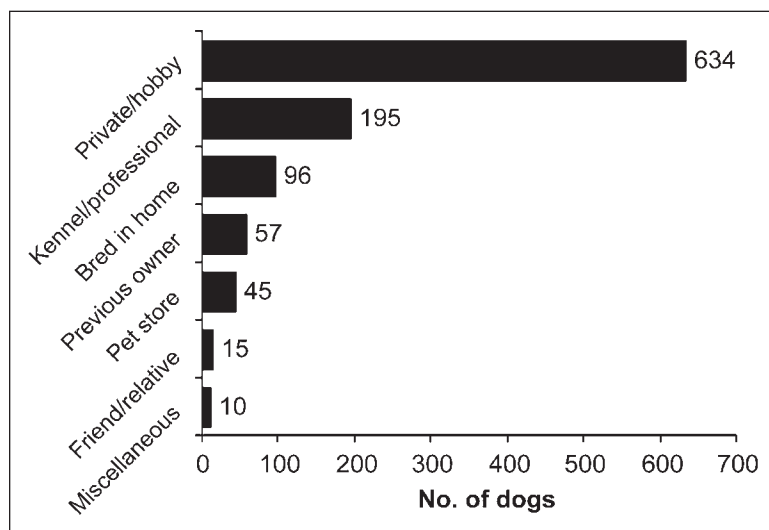


Figure 1—Sources of English Springer Spaniels in a survey of owner-directed aggression. One response was recorded as missing.

Table 1. Results of an aggression screen in a survey of owner-directed aggression in English Springer Spaniels.

Activity	N	No aggression No. (%)	Growl No. (%)	Snap No. (%)	Bite No. (%)	Total aggression No. (%)
Hug	1027	962 (93.7)	56 (5.4)	6 (0.6)	3 (0.3)	65 (6.3)
Pet on head	1029	997 (96.9)	28 (2.7)	4 (0.4)	0	32 (3.1)
Pet on back	1030	1001 (97.2)	21 (2.0)	6 (0.6)	2 (0.2)	29 (2.8)
Kiss	974	947 (97.2)	24 (2.5)	2 (0.2)	1 (0.1)	27 (2.8)
Lift	995	901 (90.5)	71 (7.1)	18 (1.8)	5 (0.5)	94 (9.4)
Stare	975	930 (95.4)	36 (3.7)	6 (0.6)	3 (0.3)	45 (4.6)
Remove dog food	977	810 (82.9)	106 (10.8)	44 (4.5)	17 (1.7)	167 (17.1)
Remove special food/bone	960	671 (69.9)	198 (20.6)	62 (6.5)	29 (3.0)	289 (30.1)
Restrain by collar or scruff	982	908 (92.5)	47 (4.8)	19 (1.9)	8 (0.8)	74 (7.5)
Scold or shout at dog	992	868 (87.5)	99 (10.0)	20 (2.0)	5 (0.5)	124 (12.5)
Threaten to hit, but do not	938	746 (79.5)	148 (15.8)	36 (3.8)	8 (0.8)	192 (20.5)
Physically punish	860	616 (71.6)	127 (14.8)	86 (10.0)	31 (3.6)	244 (28.4)
Leash correction	903	878 (97.2)	18 (2.0)	3 (0.3)	4 (0.4)	25 (2.8)
Push dog onto back	986	922 (93.5)	47 (4.8)	15 (1.5)	2 (0.2)	64 (6.5)
Command down	1000	978 (97.8)	19 (1.9)	3 (0.3)	0	22 (2.2)
Push off furniture	895	812 (90.7)	64 (7.1)	13 (1.4)	6 (0.7)	83 (9.3)
Nudge on bed or couch	904	817 (90.4)	77 (8.5)	7 (0.8)	3 (0.3)	87 (9.6)
Disturb while sleeping	894	767 (85.8)	98 (11.0)	20 (2.2)	9 (1.0)	127 (14.2)
Brush or groom	1028	974 (94.7)	32 (3.1)	18 (1.7)	4 (0.4)	54 (5.2)
Trim nails	901	817 (90.7)	52 (5.8)	22 (2.4)	10 (1.1)	84 (9.3)
Bathe	1010	982 (97.2)	26 (2.6)	1 (0.1)	1 (0.1)	28 (2.8)
Step over dog	1025	1010 (98.5)	15 (1.5)	0	0	15 (1.5)
Bend over dog	1028	995 (96.8)	33 (3.2)	0	0	33 (3.2)
Put on or take off leash	1004	994 (99.0)	8 (0.8)	2 (0.2)	0	10 (1.0)
Family member enters room	950	936 (98.5)	10 (1.0)	4 (0.4)	0	14 (1.5)
Family member leaves room	979	974 (99.5)	4 (0.4)	1 (0.1)	0	5 (0.5)
Child \leq 7 years approaches	813	739 (90.9)	55 (6.8)	13 (1.6)	6 (0.7)	74 (9.1)
Playing with child \leq 7 years	865	794 (91.8)	42 (4.8)	14 (1.6)	15 (1.7)	71 (8.2)

N = No. of dogs for which each activity applied.

ing, snapping, or biting by 510 (48%) dogs. Situations that elicited aggressive behavior to owners in > 10% of dogs included removal of a special food or bone (30%) or the dog's regular food (17%), punishment (28% reacted aggressively to physical punishment, 21% to the threat of physical punishment, and 13% to verbal scolding), and being disturbed while sleeping (14%). Targets of biting were members of the family in almost half (49%) of the instances, and household adults were twice as likely as household children to be bitten (Figure 2). In total, 65% of bites were targeted to familiar humans (owners and nonowners), whereas biting behavior directed to nonhousehold members ranged from 3% to 14%. Dogs aggressive to their owners were

more likely to be male than female, > 3 years old, neutered, and of show-type, rather than field-type, breeding (Table 2).

Dogs with owner-directed aggression were more likely to have had their availability advertised in a newspaper or posted advertisement and to have been obtained from a hobby breeder. Dogs originally obtained for hunting purposes were less likely to be owner-aggressive. Other than hunting, reasons for which the dog was obtained were not significantly associated with aggression; whether or not the dog was obtained for the purpose of protection, for example, was not associated with aggressive behavior. Dogs aggressive to their owners were more likely than dogs that were not owner-aggressive to

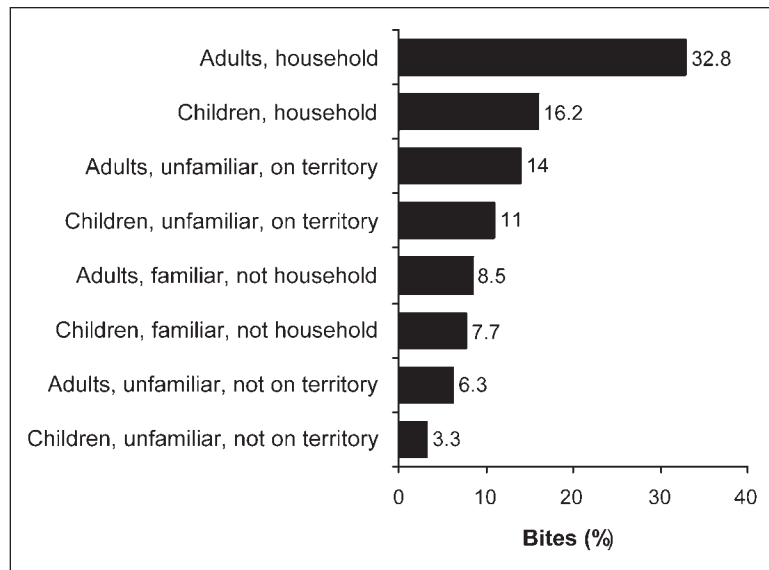


Figure 2—Targets of biting for 278 English Springer Spaniels with a history of biting; values represent percentage of total per-target bites.

Table 2—Variables significantly ($P \leq 0.05$) associated with owner-directed aggression in English Springer Spaniels.

Variable	No Aggression		Aggression to owners		OR	95% CI	P value
	N	%	N	%			
Age > 3 y	425	86	434	93	2.3	1.5–3.5	< 0.001
Male sex	231	44	258	51	1.3	1.04–1.7	0.03
Neutered	221	42	284	56	1.8	1.4–2.3	< 0.001
Show type	129	32	138	41	1.4	1.1–1.9	0.02
Source							< 0.001
Home bred	67	13	27	5	—	—	—
Professional kennel	98	18	94	18	—	—	—
Hobby breeder*	302	57	325	64	1.3	1.03–1.7	—
Other	63	12	64	13	—	—	—
Availability							< 0.001
By word of mouth	131	25	118	23	—	—	—
Called a breeder	58	11	44	9	—	—	—
Newspaper or posted ad*	198	38	256	50	1.7	1.3–2.1	—
Other	140	27	92	18	—	—	—
Obtained as a hunting dog	210	40	149	29	0.6	0.5–0.8	< 0.001
Breeding							
Presence of kennel X	77	22	131	31	1.6	1.2–2.3	0.003
Presence of sire Y	43	12	75	18	1.6	1.03–2.4	0.03
Primary attachment							0.006
Man	194	37	187	37	—	—	—
Woman*	144	27	181	36	1.5	1.1–1.9	—
Child	36	7	22	4	—	—	—
More than 1 person	154	29	116	23	—	—	—
Jumping on owners	207	45.7	246	54.3	1.5	1.1–1.9	0.002
Jumping on nonowners	220	42	299	57.6	1.6	1.3–2.1	0.001
History of biting							
Unfamiliar adult away from house, car, yard	6	1	17	3	3.0	1.2–7.7	0.02
Unfamiliar child in house, car, yard	9	2	30	6	3.6	1.7–7.7	< 0.001
Familiar adult, not family	5	1	26	5	5.7	2.2–14.9	< 0.001
Familiar child, not family	2	0	25	5	13.7	3.2–58.0	< 0.001
Other dogs in home	386	74	420	85	1.9	1.4–2.6	< 0.001

*Odds ratio (OR) calculated for this category against all others.
CI = Confidence interval. — = Not applicable.

have a history of biting unfamiliar children or adults as well as nonhousehold, but familiar, children and adults.

There were differences in dogs associated with both sex and neuter status (Table 3). Males were significantly more owner-aggressive than females when they were

hugged; petted on the head or back; lifted; or responding to a stare, threat, or physical punishment by the owner. There were significant differences between neutered and sexually intact dogs of both sexes. Neutered males were more aggressive than sexually intact males in 14 of 18

Table 3—Significant ($P \leq 0.05$) associations between sex or neuter status and aggressive behavior in English Springer Spaniels. Listed provocations (variables) elicited at least 1 episode of growling at, snapping at, or biting family members.

Variable	M (%)	MN (%)	F (%)	FN (%)	P value		
					M versus F	M versus MN	F versus FN
Hug	6.3	12.1	1.4	6.7	0.02	0.03	0.003
Pet on head	4.4	6.1	0.5	2.1	0.002	NS	NS
Pet on back	4.4	4.2	0.5	2.1	0.007	NS	NS
Lift	10.7	20.1	3.4	7.1	< 0.001	0.007	NS
Stare	4.6	11.6	1.9	2.9	0.001	0.01	NS
Remove special food	27.7	40.5	31.3	23.6	NS	0.006	NS
Remove objects	11.5	28.5	9.3	16.1	NS	< 0.001	0.034
Scold/shout at dog	13.1	21.7	5.3	12.2	0.002	0.023	0.009
Threaten to hit, but do not	19.5	35.1	9.6	21.4	0.003	< 0.001	< 0.001
Physically punish	30.2	42.5	19.8	25.4	NS	0.015	NS
Trim nails	8.1	15.7	7.6	8.6	NS	0.027	NS
Disturb sleep/rest	12.0	23.9	7.0	16.3	NS	0.003	0.003
Push off furniture	6.8	17.7	3.3	11.0	NS	0.001	0.003
Nudge on bed or couch	7.4	18.4	3.3	11.2	NS	0.001	0.002
Bend over dog	3.2	4.3	0.5	4.5	NS	NS	0.007
Restrain by collar or scruff	5.8	13.2	4.5	8.3	NS	0.01	NS
Command "down"	2.9	3.8	0.0	2.1	NS	NS	0.047
Family member enters room	0.7	3.2	0.0	2.3	NS	0.05	0.047
Playing with child ≤ 7 years	7.9	17.5	7.3	10.8	NS	0.009	NS
Unfamiliar adult approaches	70.3	80.0	70.0	81.0	NS	0.022	0.005
Another dog approaches	59.4	75.6	56.6	56.4	NS	0.01	NS
History of biting*	20.4	44.6	20.6	28.5	NS	< 0.001	0.044
Bit unfamiliar child on territory	3.5	7.8	3.7	2.4	NS	0.049	NS
Bit familiar child, nonhousehold	1.6	6.0	2.8	2.1	NS	0.012	NS
Bit household adult	8.6	19.2	9.4	12.1	NS	0.001	NS
Bit household child	2.6	10.8	3.7	7.8	NS	< 0.001	NS

*Dogs (neutered or sexually intact) with a history of biting included 138 (27.9%) males and 139 (24.9%) females.
M = Sexually intact male. MN = Neutered male. F = Sexually intact female. FN = Neutered female. NS = Not significant.

contexts of owner-directed aggression. When sexually intact females were compared with spayed females, there were significantly more owner-aggressive spayed females than expected for 10 variables. A difference between neutered and sexually intact dogs was detected even in instances in which there was no significant sex (ie, male vs female) difference (eg, aggression in response to the owner's removal of special food). There was no difference in biting history between males and females overall. However, in addition to differences seen in the aggression screen, neutered males and females were significantly more likely than their sexually intact counterparts to have bitten. Spayed females were also more aggressive than expected toward unfamiliar adults who approached ($P = 0.005$). Of 167 castrated males, 29 (17%) had been castrated because of aggression directed to humans and 10 (6%) because of aggression to dogs. However, when the 29 dogs castrated because of aggression to humans were removed from unconditional analyses, neuter status in males was still associated with aggression. In contrast, 5 (1%) ovariectomies in females were performed because of aggression to humans and none because of aggression to dogs.

Most owners (64%) trained their dogs independently and in the home, whereas 20% had taken their dog through at least 1 group obedience class. The

remaining dogs were trained in mixed settings, which included private trainers. Regardless of the type of training received, greater responsiveness to owners' cues was associated with less aggression for the cues sit, down, down-stay, come (recall), and heel (Figure 3).

Four-generation pedigrees were confirmed for 771 (73%) dogs. Of these, 265 (34% of confirmed pedigrees) listed at least 1 dog with the kennel X name. Sire Y was present in 118 pedigrees, and sire Z was present in 114 pedigrees. Kennel X and sire Y were significantly associated with owner-directed aggression (Table 2). Neither kennel X nor the individual sires Z and Y was associated with a history of biting ($P = 0.054$).

There was no significant association with owner-directed aggression or a history of biting for the variables coat color, history of seizures, history of training (vs no training), allowing the dog to sleep in the owners' bed, duration of active exercise per day, or whether the dog had bitten an unfamiliar human on the dog's territory (house, yard, or car).

Ninety-two (9%) of the respondents' dogs were no longer in the home. Of these, 40 had been euthanized and 15 had been relocated to a new home because of aggression to humans. Forty-nine had been euthanized or relocated for reasons other than aggression to humans (including aggression to other dogs); 3 dogs

were no longer in the home for unknown reasons. Euthanasia or surrender of dogs because of aggressive behavior was associated with a history of biting household adults ($P < 0.001$) and children ($P < 0.001$) and familiar (nonhousehold) adults ($P = 0.003$) and children ($P = 0.002$). In addition, euthanasia or surrender of dogs because of aggressive behavior was associated with a history of biting unfamiliar children in the house, yard, or car ($P < 0.001$). However, there was no association between removal of the dog for aggressive behavior and biting unfamiliar adults (in or away from

the house, yard, or car; $P = 0.19$) or unfamiliar children (away from the house, yard, or car; $P = 0.99$).

Regression models—All variables (excluding those on which the definition was based) were tested for association with owner-directed aggression. Multiple logistic regression analysis revealed that the following factors were independently associated with an increased risk of owner-directed aggression: being male; being neutered; having kennel X in the pedigree; having aggression to other dogs; having been found through a newspaper ad;

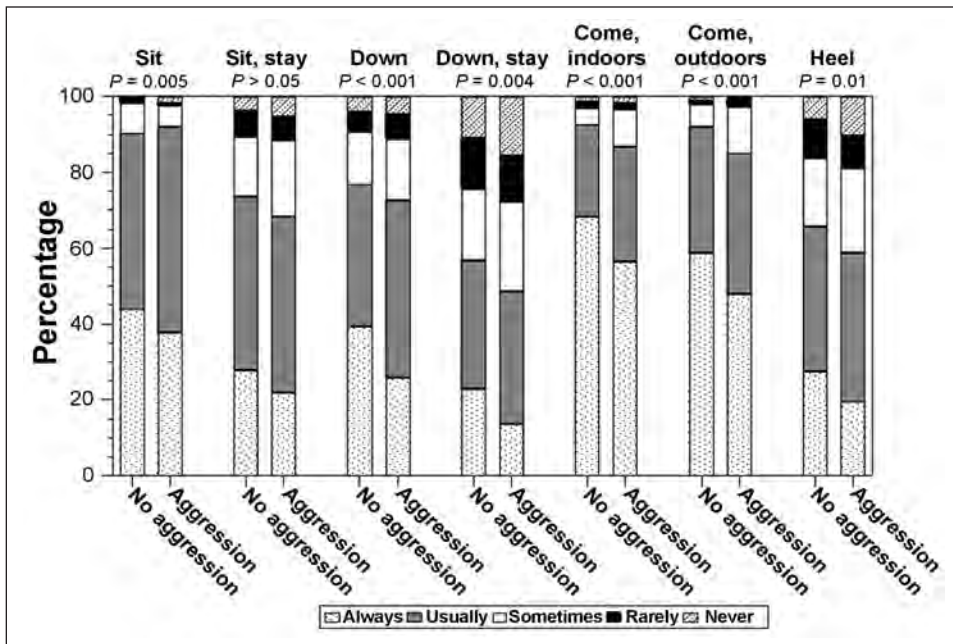


Figure 3—Association between responsiveness (always, usually, sometimes, rarely, and never) to obedience cues and aggression (percentage of dogs with or without aggression) in English Springer Spaniels.

Table 4—Logistic multiple regression models for prediction of owner-directed aggression in English Springer Spaniels.

Parameter	Estimate	SE	P value	OR	95% CI
Model 1—All dogs					
Intercept	-1.284	0.233	< 0.001	—	—
Kennel X in pedigree	0.470	0.179	0.009	1.60	1.13–2.27
Aggressive to other dogs	0.614	0.194	0.002	1.85	1.26–2.70
Male	0.520	0.166	0.002	1.68	1.22–2.33
Neutered	0.547	0.165	< 0.001	1.73	1.25–2.39
Obtained dog through newspaper ad	0.425	0.158	0.007	1.53	1.12–2.09
Familiar child, not family	2.905	1.035	0.005	18.27	2.41–138.81
Unfamiliar child in house, car, or yard	0.936	0.449	0.037	2.55	1.06–6.14
Familiar adult, not family	1.391	0.512	0.007	4.02	1.47–10.95
Model 2—Male dogs					
Intercept	-0.494	0.277	0.075	—	—
Kennel X in pedigree	0.836	0.270	0.002	2.31	1.36–3.91
Aggressive to other dogs	0.740	0.299	0.013	2.10	1.17–3.76
Familiar adult, not family	1.631	0.771	0.034	5.11	1.13–23.15
Model 3—Female dogs					
Intercept	-1.475	0.257	< 0.001	—	—
Aggressive to other dogs	0.556	0.227	0.014	1.74	1.12–2.72
Neutered	0.652	0.190	< 0.001	1.92	1.32–2.79
Obtained dog through newspaper ad	0.845	0.184	< 0.001	2.33	1.62–3.34
Familiar adult, not family	1.697	0.672	0.012	5.46	1.46–20.36

See Table 2 for key.

having aggression to a familiar child or adult that was not family; and having aggression to an unfamiliar child in the house, car, or yard (Table 4). When analyzed by sex, for females alone, the best fit model did not include kennel X in the pedigree; aggression to a familiar, non-household child; and aggression to an unfamiliar child in the house, car, or yard. In contrast, for males alone, the variables neutered; found through a newspaper advertisement; and aggression to a familiar, nonhousehold child, to an unfamiliar child in the house, car, or yard, and to a familiar nonhousehold adult were not included in the best fit model.

Discussion

English Springer Spaniels have earned a reputation for aggressive behavior directed to owners and to other familiar humans and are frequently referred to behavioral specialists for this problem. This was supported by results of our survey, in which almost half the dogs (48%) had growling, baring teeth, snapping, or biting directed to family members in contexts attributable to social conflicts or resource-guarding. More than one quarter of the dogs (26%) had a history of biting, of which 65% bit owners and familiar humans. Although aggression to owners is undesirable in any breed, it is particularly unexpected in a breed developed for its hunting (flushing) and pet qualities rather than for guarding or other human-directed aggression. A survey-based study¹⁹ of English Cocker Spaniels found that resource-guarding (possessive aggression) occurred in 24% of 932 dogs and dominance-type aggression to owners occurred in 11%. In the present study, 30% of dogs reacted aggressively when a bone or food (other than regular dog food) was removed, a percentage slightly higher than, although comparable to, possessive aggression in English Cocker Spaniels. However, the investigators of that study did not elaborate on the definition of aggression in the questionnaire, and it is unclear whether owners or unfamiliar humans were targets of other reported categories, including competitive or sudden aggression.

One well-known breeding kennel and 1 popular sire from that kennel were significantly associated with dogs that were aggressive to owners, suggesting a genetic predisposition for this behavior problem. This kennel is represented in many pedigrees (more than one third in this study), particularly in lines bred for show or the pet trade rather than for hunting or field trial competition. This kennel's presence in the pedigree has more than a random association with aggressive behavior. A more detailed analysis of the inheritance of aggressive behavior is warranted and would lead, ideally, to the avoidance of breeding the descendants of those individuals and the selective breeding of dogs with proven nonaggressive temperaments.

Logistic regression yielded a number of risk factors associated with owner-directed aggression after adjusting for other variables. Although each model represented a set of factors related within only that model, there were consistent effects among the different models.

The sex distribution of dogs in this sample was presumed to represent the sex distribution of the general population of English Springer Spaniels. We were interested in comparing the association of sex or neuter status

and owner-directed aggression in our study with the association of these variables in previous reports.^{2,4} In contrast to the predominance of males among dogs referred to a behavioral specialist for problems of aggression,¹⁶ the ratio of males to females with owner-directed aggression in this sample was closer to equal. However, as we expected, males were still significantly overrepresented among owner-aggressive dogs. There was no difference in the frequency of biting between males and females when neutered and sexually intact individuals were considered. Neutered males and females, however, were both significantly more likely than their sexually intact counterparts to have bitten. Although neutering was a risk factor for aggression when males and females were grouped, it remained a risk factor only for females when males and females were considered separately. It is interesting to note that owners of only 5 (1%) neutered females had requested surgery because of aggression to humans and none because of aggression to other dogs; in contrast, 29 (17%) castrated males had been castrated because of aggression to humans and 10 (6%) because of aggression to other dogs. Because it is often suggested by veterinarians that aggressive male dogs be castrated as treatment for the behavior problem, aggressive behavior appears to have influenced neutering in males more than in females. Conversely, it seems that castration was often the result of aggressive behavior rather than a contributing cause.

When only females were considered, sexually intact females were less owner-aggressive than neutered females, a difference seen in several circumstances, including provocations related to resting and sleeping in socially important places and being hugged and bent over or otherwise physically manipulated (restrained) or punished. In some instances, the difference between sexually intact and neutered females was quite large; these include an aggressive response to being threatened (but not hit; 10% of sexually intact females and 21% of neutered females) and aggression to the owner in response to being nudged or disturbed while resting and being pushed off furniture (3% of sexually intact females and 11% of neutered females). Other studies^{15,16,19-21} have also found that aggression was associated more with neutered than with sexually intact females. However, because most pet female dogs are neutered,² this finding may merely reflect the ratio of neutered to sexually intact females in the general population. Stronger support for the suggestion that neutered females are more aggressive, however, has been reported in a controlled study by O'Farrell and Peachey.²² Considering that only 1% of neutered females in our study were neutered because of aggression (indicating perhaps that few were aggressive prior to surgery), these findings suggest that ovariohysterectomy may contribute to owner-directed aggression or that ovarian hormones may provide a protective effect against such aggression. Neutered males were more aggressive than sexually intact males in the same contexts in which neutered females were more aggressive than sexually intact females. However, the effect of neutering in male dogs is less clear and may be confounded by the owner's reasons for neutering. Although results of the present study suggest that ovariohysterectomy may increase the likelihood of aggres-

sive behavior in female English Springer Spaniels, further study is needed of the effects of neutering on owner-directed aggression in this and other breeds.

English Springer Spaniels bred from field or hunting lines did not have owner-directed aggression and a history of biting to the extent of those bred from show, bench, or pet lines. There were several ways to identify field-bred dogs from survey results, but none was entirely objective. Owners were asked to identify which of the 2 types they owned and indicate whether they had obtained the dog for hunting purposes. The variables obtained for hunting, field type, and adult male caretaker were associated, and each influenced associations of the others. Although kennel X was less likely to be listed in the pedigrees of field-bred dogs, we did consider that dogs could be a mix of the 2 types and thus be descended from this particular line. The kennel's presence in the pedigrees of many (owner-identified) field-bred dogs indicated that the distinction between the 2 types was questionable in this study. Separating the analyses of field-bred and show- or pet-bred dogs revealed a less consistent association with owner-directed aggression or biting. However, the relationship between several variables and kennel X was consistent. For example, when only males were considered, the presence of kennel X in the pedigree predicted a doubled risk of aggression to owners. We recognize that management practices may have as important an influence as genetic background, however. Dogs bred and kept for hunting purposes, for example, were significantly more aggressive to unfamiliar adults who approached them, a characteristic that may be exaggerated in dogs that are housed outdoors, as may be the case with hunting dogs.

Dogs obtained from hobby breeders or private homes were 30% more likely to be aggressive to owners than were dogs bred in the respondent's own home or obtained from a professional breeder or kennel, previous owner, pet store, society for the prevention of cruelty to animals, or other sources. These results are difficult to interpret because of the challenge of measuring competence, experience, or even ethics of individual breeders. For example, although the term hobby breeder may evoke an image of an individual with little experience who has bred his or her bitch with little regard for temperament or physical attributes, it is a term also used to describe individuals who are heavily involved in dog shows, campaign their dogs in breed competition as well as sports, and are concerned with temperament. Similarly, the term professional breeder may imply experience and commitment to the quality of the breed, or it may refer to an individual whose goal in breeding is primarily monetary. The majority ($n = 634$ [60%]) of dogs in this survey had been obtained from a hobby or private home breeder. Learning about the availability of the dog through a newspaper ad was significantly associated with owner-directed aggression, as we expected: reputable or knowledgeable breeders are less likely to advertise availability of puppies in newspapers. There is at present no reliable method for evaluating quality or regard for health and temperament among dog breeders. The contribution of genetics and early environment to temperament is critical,²³ and it would be informative to develop an objective classification of breeders.

A history of aggression to nonowners was a risk factor for aggression to owners. Dogs that barked, growled, snapped, or bit when approached by unfamiliar adults and those that had bitten an unfamiliar child on the dog's territory were more likely to also be owner-aggressive. Aggression to unfamiliar humans is usually classified as territorial or protective aggression² and is believed to be distinct in motivation from owner-related aggression, particularly when such aggression is attributed to social dominance. However, in the present study, there was a meaningful association between the 2 classifications, both of which may involve fear or anxiety (self-defense). Biting an unfamiliar child in the home, yard, or car is characteristically different in many instances from biting an adult because children are often already in the home (eg, as guests) when bitten. It is unclear whether these are victims of social conflict, fear, or territorial behavior.

We attempted to distinguish between a history of obedience training and the owner's perception of the dog's responsiveness to cues. It did not make a difference whether dogs were trained at home by owners or by a private trainer or had 1 or more formal obedience class. A study²⁴ of environmental associations with high versus low aggression in English Cocker Spaniels found no differences in the amount of training between the 2 groups. Other studies^{23,25} have concluded that obedience training may be associated with fewer problem behaviors. In addition to information about training history, we asked owners about their dogs' responsiveness to obedience cues. Regardless of type or duration of training, responsiveness to the owners' cues (obedience) played a protective role: dogs that were responsive at least 75% of the time to obedience cues were less likely to have owner-directed aggression. Voith et al²⁶ reported that obedience training was not significantly associated with problem behaviors. However, their study did not specifically address the association between such aggression by dogs and their response to obedience cues, regardless of the level of training completed. Further study of the influences of training and the association between responsiveness to owner cues and owner-directed aggression would be informative.

More than 80% of dogs received more than 15 minutes of active exercise daily (in addition to time alone outdoors). Duration of active exercise was not associated with aggression. Further information regarding type of exercise, on and off lead, is needed before conclusions can be reached regarding associations between exercise and behavior.²⁷

Dog owners vary in their tolerance of aggressive behavior. In a study²⁸ of 12 animal shelters, aggression was the primary reason for relinquishment of dogs. A study¹⁶ of risk factors for behavior-related euthanasia revealed that owners of dogs with a history of unpredictable and poorly inhibited aggression were more likely to choose euthanasia for the dog than were owners of aggressive dogs without those characteristics. In another survey of dog owners, 9% of dogs of a variety of pure and mixed breeds in a general population that were no longer living with their owners were euthanized or relocated because of aggressive behavior²⁹; however, the prevalence of euthanasia or relinquish-

ment because of aggressive behavior problems in a single breed has not been reported. In our survey, 40 of the 92 (43%) English Springer Spaniels that were no longer in the home had been euthanized or relinquished specifically because of aggression to humans. Furthermore, there was a significant association between euthanasia or relinquishment because of aggression and a history of biting household adults and children or familiar (but not household) adults and children. There was no association between surrender of the dog and biting unfamiliar adults either on or off the dog's property. These findings underscore the reputation of English Springer Spaniels for aggression to family members and other familiar humans. It could be informative to compare these reasons for euthanasia or surrender with those for other pure breeds.

The underlying cause of owner-directed aggression in English Springer Spaniels is unclear but is likely to be multifactorial. Dominance-related aggression (when aggressiveness to owners related to punishment and resource-guarding are included) is the most frequently diagnosed canine behavior problem in several reports.^{1,2,30} The clinical definition of dominance-related aggression is derived from dominance-subordination relationships among members of a wolf pack.³¹ It has been suggested that aggression may result when owners, deliberately or inadvertently, threaten or challenge the dog's social status³¹ in situations of competition over resources (eg, food, bedding, or favored family members) or when there is a perceived (eg, postural) challenge to their rank within the family dominance hierarchy.^{2,3,30-32}

However, the diagnosis of dominance-related aggression has recently been questioned.^{33,34} Behaviorists have come to understand that aggression to owners differs from dominance-related conflict in several ways. First, whereas dominance hierarchies usually are intraspecific, dominance-related aggression (by conventional definition) is directed toward humans. Whether dogs view human owners as conspecifics is questionable. Second, although some competitiveness for higher rank is a desirable and adaptive behavior in wolves, such a tendency in dogs is considered inappropriate and leads to disruption of the human-dog relationship.³⁵ Third, dominant-acting dogs should appear confident and have assertive postures and other behaviors; in fact, the opposite is most often true in instances of owner-directed aggression.^b In most instances of owner-directed aggression reported at the Behavior Clinic of the Matthew J. Ryan Hospital of the University of Pennsylvania, fear-related aggression and anxiety are included in the behavioral diagnosis. Furthermore, the clinical interpretation of dominance-related aggression in dogs has varied, leading to inconsistencies in diagnosis. For example, growling or biting behavior by dogs in relation to punishment or resource-guarding (the latter in the absence of aggression to the owner in other situations) has been included in the definition of dominance-related aggression by some investigators¹⁶ but not others.⁵ Finally, the assertion that owner-directed aggression in English Springer Spaniels is not primarily driven by social dominance is supported by our finding of an association between owner-directed aggression and aggression to nonhousehold or unfamiliar humans.

The interpretation of findings in a mail survey-based study should be made with some caution because of the potential for responder bias.^{36,37} Bias may have skewed results in either direction: there may have been an increased rate of response by owners of aggressive dogs eager to report their experiences or there may have been reluctance to report aggressive behavior, thereby underreporting its incidence. Although our survey methods followed recommendations associated with increased response, it is important to consider that nonresponders (or their dogs) may significantly differ from responders.

More complex pedigree analysis as well as research involving the neurobiology of aggression is needed to more effectively understand this behavior and its inheritance. In many clinical situations, even mild instances of owner-directed aggression in English Springer Spaniels have been labeled rage. Further study may lead to a more objective distinction between this maladaptive (or incorrectly identified) behavior and normal, but inappropriate, aggression.

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

Pharmacokinetics of a single dose of enrofloxacin administered orally to captive Asian elephants (*Elephas maximus*)

Carlos R. Sanchez et al

Objective—To determine the pharmacokinetics of enrofloxacin after oral administration to captive elephants.

Animals—6 clinically normal adult Asian elephants (*Elephas maximus*).

Procedure—Each elephant received a single dose of enrofloxacin (2.5 mg/kg, PO). Three elephants received their complete diet (pellets and grain) within 2 hours after enrofloxacin administration, whereas the other 3 elephants received only hay within 6 hours after enrofloxacin administration. Serum concentrations of enrofloxacin and ciprofloxacin were measured by use of high-performance liquid chromatography.

Results—Harmonic mean half-life after oral administration was 18.4 hours for all elephants. Mean \pm SD peak serum concentration of enrofloxacin was 1.31 ± 0.40 mg/mL at 5.0 ± 4.2 hours after administration. Mean area under the curve was 20.72 ± 4.25 (mg \times h)/mL.

Conclusions and Clinical Relevance—Oral administration of enrofloxacin to Asian elephants has a prolonged elimination half-life, compared with the elimination half-life for adult horses. In addition, potentially therapeutic concentrations in elephants were obtained when enrofloxacin was administered orally at a dosage of 2.5 mg/kg. Analysis of these results suggests that enrofloxacin administered with feed in the manner described in this study could be a potentially useful antimicrobial for use in treatment of captive Asian elephants with infections attributable to organisms, such as *Bordetella* spp, *Escherichia coli*, *Mycoplasma* spp, *Pasteurella* spp, *Haemophilus* spp, *Salmonella* spp, and *Staphylococcus* spp. (*Am J Vet Res* 2005;66:1948–1953)



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