Characteristics, treatment, and outcome of 99 cases of aggression between dogs

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Abstract

Cases of aggression between dogs (n = 99) treated at the Animal Behavior Clinic, Cornell University (1983–1993) were analyzed retrospectively. Data were obtained from case histories; follow-up information was collected by telephone interviews and mailed questionnaires. Aggression occurred in two contexts. The primary complaint was conflict between dogs in the household in 73 cases, and aggression directed at non-household dogs in 26 cases. Dogs that started fights were pure-bred in 70 cases (71%); German Shepherd Dogs were most numerous of 38 breeds represented. Compared with American Kennel Club registrations, household aggression was less frequent among toy and sporting breeds, and more numerous among herding and non-sporting breeds (P ≤ 0.054). Terrier breeds were more prevalent among cases of non-household aggression (P < 0.01). Overall, more females initiated household aggression, whereas more males attacked non-household dogs (P < 0.05). For household aggression, same-sex pairs, especially females, were far more numerous than opposite-sex pairs (P < 0.001). Of dogs that started household fights, 58% were younger and 59% arrived in the home more recently than the target dog. Household fights were more injurious than fights with outsiders (P < 0.001); fights between female housemates tended to be more severe than other gender combinations (P = 0.057). Excitement was the most frequent trigger of household fighting. Treatments most often recommended for household aggression were desensitization with counterconditioning and obedience training, neutering and a head halter were most often suggested for non-household aggression. In owners’ opinions, treatment improved 59% of household cases and 52% of non-household cases. After treatment, 56% of dogs exhibiting household aggression could be together when supervised, whereas 76% of those exhibiting non-household aggression could be around outsiders under leash control. Cases of household aggression in which the attacking dog was younger than its target, a

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person had been bitten, or the owner could not predict aggressive episodes were less likely improved than cases in which these situations did not occur \((P < 0.05)\). Manifestations of aggression between housemates and toward non-household dogs are similar to dominance conflicts and territorial defense, respectively, in wolves. Comparisons between dog and wolf behavior may lead to improved treatment and resolution of aggression between dogs.

**Keywords:** Dog; Aggression; Behavior; Dominance; Territory; Wolf

### 1. Introduction

Aggression between dogs (*Canis familiaris*), including growling, snarling, barking, snapping, and biting, has been discussed as a problem for many years in the scientific literature (Voith, 1980; Borchelt and Voith, 1982; Beaver, 1983; Borchelt, 1983; Houpt, 1983; Hart and Hart, 1985; Landsberg, 1991) and in popular books (Campbell, 1975; Dunbar and Bohnenkamp, 1985; Hart and Hart, 1988). Both fighting dogs and the people trying to separate them may be injured. Owners of fighting dogs may face expensive medical and veterinary bills, as well as liability risks. The relationship between owners and aggressive dogs is likely to deteriorate, leading to surrender or euthanasia of pets.

The reported incidence of intraspecific aggression varies, but differences in how the data are analyzed make comparisons difficult. In a survey of 2249 dog owners, some of whom reported no behavior problems, 3% indicated that their dog(s) fought (Campbell, 1975, pp. 31–33). All other data are from cases referred to behavioral practices. Several investigators included all cases regardless of whether fighting was the primary or secondary complaint. Among these, Borchelt (1983) reported that 12% of 373 aggression problems involved fighting, and Beaver (1983) found that 50 of 120 dogs (42%) treated in 110 cases of aggression exhibited intraspecific aggression. At three referral practices, the frequency of aggression between dogs ranged from 8 to 19% of all aggression cases (Landsberg, 1991). Two other studies used only the primary behavioral problem to determine the frequency of intraspecific aggression. Of 98 aggression cases treated at Cornell University by Houpt (1983), 14% involved fighting, and at a clinic in Great Britain approximately 20% of 300 cases were presented for intraspecific aggression (Mugford, 1984).

Male dogs are usually considered more likely to fight than females, especially with other males (Voith, 1980; Hart and Hart, 1985). Borchelt (1983), found that 67% of 46 dogs that fought were sexually intact or neutered males, and Beaver (1983) reported that intact males were three times more likely to exhibit conspecific aggression than females or neutered males. However, Landsberg (1991) found no gender differences among cases of intraspecific aggression.

Aggression can be directed toward dogs living in the home or toward non-household dogs (Campbell, 1975; Beaver, 1983; Borchelt and Voith, 1982; Mugford, 1984; Hart and Hart, 1985; Landsberg, 1991). However, in most reports these contexts were not considered separately (Voith, 1980; Beaver, 1983; Borchelt, 1983; Borchelt and Voith, 1985; Wright and Nesselrote, 1987; Overall, 1993b). No study of clinical cases has dealt exclusively with aggression between dogs.
Here we describe the distribution of aggression directed at household or outsider dogs, characteristics of dogs that fought, frequency and intensity of aggression, and situations that triggered fights, treatments recommended by clinicians and used by clients, and resolution of cases of aggression between dogs treated at the Animal Behavior Clinic of the College of Veterinary Medicine at Cornell University. We also compare aggression among wild and captive wolves (*Canis lupus*), the closest phylogenetic relative of dogs (Morey, 1994), with aggressive behaviour we analyzed in the dog

2. Methods

2.1. Animals

We analyzed all cases seen at the Animal Behavior Clinic (A.B.C.) from April 1983 through August 1993 in which the presenting complaint was aggression toward other dogs. The clinicians who treated the dogs were the second and fourth authors and Dale D. Olm, D.V.M. Cases were categorized in two ways. First, they were grouped according to the owners’ primary concern: either aggression between dogs living in the home (household) or aggression toward dogs that were not household members (non-household). This approach, suggested by Houpt (1983) and Mugford (1984), was used rather than the classification system proposed by Borchelt and Voith (1982) for reasons described in Section 4.3. Second, some dogs were aggressive in both situations, enabling us to increase sample sizes for some analyses by including all dogs that exhibited aggression toward another dog living in the home (all household) or toward a dog living in another home (all non-household), regardless of the primary complaint.

The dog that appeared to start all or most fights was called the initiating dog. For household aggression the other dog involved was called the target dog. Dogs that fought were classified by sex (M or F). For some analyses these categories were subdivided as: sexually intact male (MI), neutered male (MN), sexually intact female (FI), or neutered female (FN). When describing pairs of dogs that fought, the sex of the initiating dog was listed first.

Each initiating dog was identified either as a breed recognized by the American Kennel Club (AKC), or a mixed breed. To compare breed frequencies, we used AKC registration statistics from 1983, 1988 and 1993 (Mandeville, 1984; Mandeville, 1989; Mandeville, 1994) to span the years over which cases were treated. For each group, the percentage of AKC registrations (3-year sum for group/total number of dogs registered) was used to calculate the expected number of dogs. Although this comparison is not ideal because it may not reflect regional breed frequencies, it does mirror changes in breed registrations over time.

The intensity of the worst fight described by each client was scored as: (1) no contact; (2) contact but no injury; (3) contact with minor injury; or (4) contact with injury requiring veterinary treatment. Frequency of household fighting was classified as: (a) less than once per month; (b) one–three times per month; (c) once per week; (d) two–six times per week; (e) once daily; (f) more than once daily. For non-household
aggression, frequencies were scored as a percentage of all opportunities to fight: (a) 25% or less; (b) 26–50%; (c) 51–75%; (d) 76% or greater.

We attempted to contact all owners for information about which treatments had been used; however, we did not assess how long or skillfully each treatment was used. Two of us (C.K.S. and L.T.) contacted clients by telephone from September to November 1993, and in January 1994. If telephone contact was unsuccessful, questionnaires were mailed in December 1993 and January 1994. If neither method was successful, we used partial follow-up information previously obtained by the clinician by postcard, letter, or telephone. A list of treatments suggested by the clinician was obtained from the discharge sheet or post-consultation letter sent to each client.

We used two measures of resolution of the aggression problem: the owner’s opinion and the dog’s behavior. During follow-up interviews each owner was asked whether the situation was: (a) completely resolved; (b) improved; (c) unchanged; (d) worse. For household aggression, dog behavior was assessed by asking owners whether: (a) dogs can be together without supervision; (b) dogs can be together only under supervision; (c) dogs are separated 100% of the time; (d) dog(s) given away; (e) euthanized because of problem. For non-household aggression, the behavior variables were: (a) dog can have contact with some unfamiliar dogs without supervision; (b) dog can have contact with all unfamiliar dogs only when under control; (c) dog cannot have any contact with unfamiliar dogs; (d) dog given away; (e) euthanized because of problem.

2.2. Analyses

The data were analyzed using StatView™ II (Abacus Concepts, Inc., Berkeley, CA). Nonparametric tests were used, including $\chi^2$ (when 80% or more of expected values were 5 or greater), Mann–Whitney U-test, Kruskal–Wallis test, and Spearman’s rank correlation coefficient (Sokal and Rohlf, 1981). Unless otherwise specified, all tests were two-tailed and $\alpha$ was 0.05. Test statistics corrected for ties were used to assess significance. Median, first (Q1), and third (Q3) quartiles were used to characterize the central tendency of variables.

3. Results

3.1. Characteristics of households and dogs

Ninety-nine cases of aggression between dogs were treated at the ABC from 1983 to 1993. The primary problem was household aggression in 73 cases (74%) and non-household aggression in 26 cases (26%). Fifty-two percent of the consultations were made as home or clinic visits, and 47% were done by telephone; the type of consultation was unknown in one case. We obtained follow-up information for 87 cases (88%): 69 by telephone, nine by mailed questionnaire, and nine by the clinician after the initial consultation.

Seventy dogs (71%) that initiated aggression were breeds recognized by the AKC (Table 1); 38 breeds in six of the seven AKC groups made up our sample.
Table 1
Number of pure-bred dogs initiating fights in 51 cases of household aggression and 19 cases of non-household aggression

<table>
<thead>
<tr>
<th>Sporting</th>
<th>Hound</th>
<th>Working</th>
<th>Terrier a</th>
<th>Non-sporting</th>
<th>Herding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer, German Shorthair</td>
<td>(3.0)</td>
<td>Dachshund</td>
<td>(1.0)</td>
<td>Akita</td>
<td>(0.2)</td>
</tr>
<tr>
<td>Retriever, Golden</td>
<td>(0,1)</td>
<td>Ibiza Hound</td>
<td>(0,1)</td>
<td>A. Malamute</td>
<td>(1,0)</td>
</tr>
<tr>
<td>Retriever, Labrador</td>
<td>(1,1)</td>
<td>Irish Wolfhound</td>
<td>(1,0)</td>
<td>Bullmastiff</td>
<td>(2,0)</td>
</tr>
<tr>
<td>Setter, Irish</td>
<td>(0,1)</td>
<td></td>
<td></td>
<td>Doberman P.</td>
<td>(4,2)</td>
</tr>
<tr>
<td>Spaniel, Cocker</td>
<td>(1,0)</td>
<td></td>
<td></td>
<td>Gr. Pyrenees</td>
<td>(1,0)</td>
</tr>
<tr>
<td>Spaniel, English Springer</td>
<td>(1,2)</td>
<td></td>
<td></td>
<td>Newfoundland</td>
<td>(1,0)</td>
</tr>
<tr>
<td>Vizsla</td>
<td>(1,0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values in parentheses: the first number represents household cases, the second, non-household cases.

a No cases of aggression occurred among breeds in Toy Group.
terriers, a breed not recognized by the AKC, initiated fights in three cases (3%) of household aggression. Mixed breed dogs started fights in 26% of cases (household \( n = 19 \), non-household \( n = 7 \)). Compared with combined AKC registrations in 1983, 1988, and 1993 (Fig. 1), among household cases, breeds in the toy \( (\chi^2 = 8.66, \text{d.f.} = 1, \ P = 0.003) \) and sporting groups \( (\chi^2 = 3.72, \text{d.f.} = 1, \ P = 0.054) \) were less numerous than expected; herding \( (\chi^2 = 13.08, \text{d.f.} = 1, \ P = 0.003) \) and non-sporting breeds \( (\chi^2 = 3.71, \text{d.f.} = 1, \ P = 0.054) \) were more frequent than predicted. Among non-household cases, terriers were more prevalent than expected \( (\chi^2 = 6.97, \text{d.f.} = 1, \ P = 0.008) \), and toy breeds tended to be less frequent \( (\chi^2 = 3.28, \text{d.f.} = 1, \ P = 0.07) \).

The three most numerous AKC breeds were the German Shepherd Dog \( (11\%, \ n = 8) \), Doberman Pinscher \( (9\%, \ n = 6) \), and Lhasa Apso \( (6\%, \ n = 4) \); Table 1); they accounted for 5%, 3% and 2% of the 3-year AKC registrations, respectively. These breeds were significantly more numerous among our cases than predicted by their AKC registrations \( (\text{German Shepherd Dog} \ \chi^2 = 4.91, \text{d.f.} = 1, \ P = 0.027; \text{Doberman Pinscher} \ \chi^2 = 7.47, \text{d.f.} = 1, \ P = 0.006; \text{Lhasa Apso} \ \chi^2 = 4.93, \text{d.f.} = 1, \ P = 0.026) \).

Owners whose dogs fought with housemates owned a median of three dogs \( (Q1 = 2 \text{ dogs}, \ Q3 = 4, \ n = 73, \text{range 2–10}) \). Household aggression cases always involved a pair of dogs that fought most often, although other dogs in the house were sometimes involved \( (\text{median number fighting dogs was two}, \ Q1 = 2, \ Q3 = 3, \ n = 72, \text{range 2–6}) \). In 63 cases \( (86\%) \) of household aggression, owners reported that only one dog initiated fights; in the remaining ten cases owners reported that the dog that was usually attacked also started some fights.

Owners of dogs exhibiting non-household aggression had fewer dogs in their homes \( (\text{median was two dogs}, \ Q1 = 1, \ Q3 = 2, \ n = 26, \text{range 1–5}) \) than in cases of household aggression \( (\text{Mann–Whitney} \ U\text{-test}, \ z = -4.74, \ P = 0.0001) \). In 12 of 26 non-household cases \( (46\%) \) there were no other dogs living in the home. Of 14 cases with multiple dogs, six \( (23\%) \) did not report any fighting among housemates \( (\text{M-M}, \ 1; \text{M-F}, \ 4; \text{F-M}, \ 1) \), whereas seven \( (27\%) \) did have some aggression between household dogs \( (\text{F-F}, \ 2; \text{M-F}, \ 5) \); data were missing in one case \( (4\%) \).
The sex of the initiating dog was significantly different for cases of household and non-household aggression (Fig. 2a; $\chi^2 = 10.15$, d.f. = 3, $P = 0.017$). More females (both sexually intact and neutered) started fights within the household, whereas more neutered males attacked non-household dogs. Among cases of household aggression, pairs of females were the most frequent gender combination (Fig. 2b). Opposite-sex pairs were much less common, but among them females were twice as likely to attack males as vice versa. Thus, the sex of the initiating and target dog were not independent ($\chi^2 = 24.00$, d.f. = 1, $P = 0.0001$).

Information on the sex of target dogs was available in 21 cases of non-household aggression (all non-household cases, regardless of primary complaint). Among initiating dogs were 10 MN (48%), 6 MI (28%), 4 FN (19%), and 1 FI (5%). According to their owners, 38% of the dogs (4 MN and 4 MI) were more aggressive toward males, whereas 62% attacked both males and females.

Forty-one pairs of dogs that fought in the home (51% of all household cases, regardless of primary complaint) were the same breed; the remainder (39 pairs) were different breeds or mixed breeds.Weights were obtained for 26 of the 39 cases of different breeds from case histories or AKC breed standards. In 22 cases (85%) the heavier dog was the aggressor. Pairs of dogs that fought were related in 15% ($n = 12$) of 80 cases of all household aggression. Among females there were five pairs of littermate sisters, one pair of non-littermate sisters, and one daughter attacking her mother. Among males there were one father attacking his son, one son attacking his father, one pair of littermate brothers, and one pair of brothers from different litters. The only opposite-sex related pair was a son that attacked his mother.

The median age of initiating dogs in cases of household aggression was 42 months
(Q1 = 26.8, Q3 = 60, n = 73, range 4.5–156); likewise the median age of initiators of non-household aggression was 42 months (Q1 = 26.3, Q3 = 58.5, n = 25, range 8–96; Mann–Whitney U-test, P > 0.30). The median age of target dogs in household cases was 56 months (Q1 = 24, Q3 = 99, n = 73, range 2–192); no equivalent data were available for non-household cases.

In the majority of household aggression cases, the initiating dog was younger (42/73 = 58%), and was obtained after the target dog (41/69 = 59%). Nine pairs of dogs (12%) were the same age, and four (6%) joined the household at the same time. In five of the cases in which the initiating dog was older than the target dog, an adult (one MI, three MN, one FN) attacked a 2–3 month old puppy (one M, three F, one sex unknown) that had recently been added to the home.

3.2. Frequency, intensity, and triggers of fights

The distribution of the frequency of household aggression was bimodal. Thirteen of 67 pairs (19%) fought more than once a day, whereas 35 pairs (52%) fought either one to three times per month, or less than once per month. In contrast, 79% (19/24) of dogs that were aggressive toward non-household dogs fought more than 75% of the time they had the opportunity to do so. Although F-F pairs were more numerous among cases of household aggression, they did not fight more frequently than M-M, F-M, or M-F pairs (Kruskal–Wallis test, d.f. = 3, P > 0.50).

Fights were significantly more intense for dogs exhibiting household aggression compared with non-household aggression cases (Mann–Whitney U-test, n = 96, z = −3.20, P = 0.0007). Of household cases, 78% involved minor or serious injury, whereas 56% of dogs in cases of non-household aggression had not injured any dogs. Household F-F fights tended to be more intense (median score was 4, Q1 = 3, Q3 = 4, n = 34) than M-M fights (median was 3, Q1 = 2, Q3 = 4, n = 21), F-M fights (median was 3, Q1 = 3, Q3 = 4, n = 10), or M-F fights (median was 2, Q1 = 1.75, Q3 = 3, n = 5; Kruskal–Wallis, d.f. = 3, H = 7.51, P = 0.057).

Aggression between some dogs in the home was so severe before treatment that 19 pairs (26%, n = 73) could not be together without fighting. Eight (42%) of these pairs were females, six (32%) were males, and five (26%) were opposite-sex. Twenty-one (29%, n = 73) owners of dogs that fought with housemates reported that at least one person had been bitten while stopping a fight; however, only one (4%, n = 26) owner of a dog exhibiting non-household aggression was bitten while restraining her dog.

Owners reported that a number of different situations led to fighting (Fig. 3). In aggression between household dogs, the three most frequent triggers were excitement, the presence of food or a toy, and proximity to the owner. Although the owner’s proximity was a prevalent trigger, 12 pairs of dogs (all household cases, regardless of presenting complaint) fought at least once when owners were absent, including one pair that fought only when alone in a car. Non-household aggression was elicited by contact with outsider dogs, many of which were unfamiliar. In other cases the target dog lived nearby and was attacked regularly. Dominant postures by the initiating dog preceded a fight in three cases, and two owners were unable to determine which non-household dogs would elicit aggression.
Fig. 3. Triggers of fighting in 73 cases of household aggression and 26 cases of non-household aggression. Circumstances taken from case histories. Numbers in parentheses are the numbers of cases responding to each trigger. Total percentages are greater than 100% because more than one situation elicited aggression in some cases. Some categories are self-explanatory; examples of others include: Excitement (greetings, play, loud voices, walks, car rides), Food/Toy (proximity to food, objects, food or water bowl), Confined Space (hall, doorway, car), Undetermined (owner cannot predict aggression), Redirected (aggression toward an unfamiliar dog, cat or other stimulus is redirected to a household dog), Facilitated (initiating dog attacks target dog after owner punishes target dog), After Separation (dogs reunited after temporary separation).

Estrus or pregnancy was associated with fighting between household dogs in ten cases (all household cases; eight F-F pairs, one F-M pair, one M-F pair). Aggression began when an older female attacked a younger female that was in estrus (five cases) or pregnant (one case). In one case a younger, sexually intact female was more aggressive toward an older neutered female when in estrus. In two cases, a female with pups attacked another dog in the home (one FN and one MI) after it growled at her pups; these females continued to be aggressive after the pups were weaned. One sexually intact male was more aggressive toward a female in the household when she was in estrus.

3.3. Other behavior problems

Owners of 84 (85%) dogs that started fights in household and non-household cases reported other problem behaviors (Table 2). There were several differences in the
Table 2
Percentage of owners reporting other behavior problems among 73 cases in which the primary complaint was household aggression and 26 cases in which the primary complaint was non-household aggression

<table>
<thead>
<tr>
<th></th>
<th>Household</th>
<th>P</th>
<th>Non-household</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Total percentage of dogs with other problems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggression toward people b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dominance</td>
<td>23 (17)</td>
<td>#</td>
<td>42 (11)</td>
</tr>
<tr>
<td>Territorial</td>
<td>32 (23)</td>
<td>NS</td>
<td>23 (6)</td>
</tr>
<tr>
<td>Fear/pain/redirected</td>
<td>7 (5)</td>
<td></td>
<td>0 (0)</td>
</tr>
<tr>
<td>Predatory aggression (non-human) c</td>
<td>8 (6)</td>
<td>**</td>
<td>35 (9)</td>
</tr>
<tr>
<td>Elimination problems c</td>
<td>18 (13)</td>
<td>*</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Out of control d</td>
<td>10 (7)</td>
<td>#</td>
<td>23 (6)</td>
</tr>
<tr>
<td>Noise phobias c</td>
<td>8 (6)</td>
<td>NS</td>
<td>8 (2)</td>
</tr>
<tr>
<td>Destructive</td>
<td>3 (2)</td>
<td></td>
<td>12 (3)</td>
</tr>
<tr>
<td>Other (flank sucking, poor mothering)</td>
<td>3 (2)</td>
<td></td>
<td>0 (0)</td>
</tr>
<tr>
<td>Aggression toward dogs</td>
<td>49 (36)</td>
<td>NS</td>
<td>31 (8)</td>
</tr>
</tbody>
</table>

Non-household/household e | 61 (8) |

a Comparisons between household and non-household cases: \( \chi^2 = 5.33, d.f. = 1, P = 0.021 \). In contrast, non-household aggression was associated with predatory behavior toward animals \( \chi^2 = 10.39, d.f. = 1, P = 0.001 \). Dogs exhibiting non-household aggression also tended to show dominance aggression toward their owners \( \chi^2 = 3.42, d.f. = 1, P = 0.064 \), and be out of control \( \chi^2 = 3.06, d.f. = 1, P = 0.08 \), but these differences were not significant. The number of dogs primarily aggressive in the household that were also aggressive toward non-household dogs did not differ from the number of dogs primarily aggressive toward outsiders that also fought in the home.

3.4. Treatments

Treatment recommendations are illustrated in Fig. 4. For household aggression, clinicians most often suggested systematic desensitization (Hart and Hart, 1985; Overall, 1993c) with counterconditioning (Campbell, 1975; Voith, 1980; Overall, 1993c), and obedience training. For non-household aggression, neutering was advised in all of five cases involving sexually intact males, and a head halter (Gentle Leader*-Promise*, Ameri-pet, Golden, CO) was recommended in 90% of cases treated after 1987. The percentage of owners using the clinicians' suggestions varied from a high of 88% (Fig. 4, avoid triggers in household cases) to a low of 13% (use muzzle in non-household
In cases of household aggression, owners most often avoided triggers, temporarily separated their dogs, and increased obedience training, whereas owners whose dogs attacked outsiders most often increased obedience training, avoided triggers, and used a head halter.

Owners whose dogs fought in the home were told either to treat one dog as more dominant by praising and feeding it first, and scolding lower ranking dogs for exhibiting aggression, or to reduce the privileges and ranks of both dogs by keeping them off furniture and reducing attention and gratuitous petting. A few owners whose dogs were aggressive toward non-household dogs were also told to reduce their dog's privileges. Other treatments were recommended in both types of aggression cases. Drug treatments included: megestrol acetate (ten cases), L-tryptophan (three), unspecified tranquilizers (three), fluoxetine (two, Prozac*, Eli Lilly, Indianapolis, IN), buspirone (two, Buspar*, Mead Johnson, Princeton, NJ), phenobarbital (one), clomipramine (one), amphetamine (one), and lithium carbonate (one). The use of muzzles and leashes was discussed for prevention of injury. Aggression was avoided by use of such restraint and distraction devices like loud or ultrasonic noise. Other management suggestions included reduced protein in the diet, increased exercise, and keeping a detailed log of aggressive behavior.

Clients occasionally tried methods not specifically suggested by the ABC. Some owners (21/64 = 33%) permanently separated dogs that fought in the home, which
ended the problem but did not change the behavior. To stop fights some owners tried electronic shock collars, and one used a fly swatter. One client poured vinegar on her fighting dogs, and reported that thereafter a drop of vinegar near them would end aggressive displays.

3.5. Case outcome

The first measure of outcome was the opinion of owners. For household aggression \( (n = 66) \), 14% of owners felt the problem was completely resolved after treatment, 45% thought the problem was improved, 29% reported that the situation was unchanged, and 12% reported that the situation was worse. Among cases of non-household aggression \( (n = 21) \), no clients reported either complete resolution or worsening of the aggression. However, 52% felt the problem was improved, and 48% stated the problem had not changed. The owners’ opinions of the effects of treatment were not significantly different for household and non-household aggression (Mann–Whitney U-test, \( P > 0.15 \)).

The second measure of outcome was each dog’s behavior after treatment. Of dogs exhibiting household aggression \( (n = 61) \), 36% could be together unsupervised, 20% could be together only when supervised, 18% were separated permanently, 18% were given to new homes, and 8% were euthanized because of the problem. For cases of non-household aggression \( (n = 21) \), 33% of dogs could be around some dogs without owner control, 43% could be near dogs only when leashed, 10% were not permitted any contact with dogs, 9% were given away, and 5% were euthanized. The difference in distribution of behavioral outcomes between cases of household and non-household aggression was not significant (Mann–Whitney U-test, \( P > 0.20 \)).

In cases of household aggression, fights between females did not have a worse outcome than fights between other gender combinations (Kruskal–Wallis test, owner’s opinion \( P > 0.30 \), dog’s behavior \( P > 0.10 \)). Among all cases of household aggression (regardless of primary complaint), if the initiating dog was younger than the target dog, the behavioral outcome was worse than if the initiating dog was older than the target dog. Assessment of the dog’s behavior was negatively correlated with the difference in age (Spearman’s rank correlation, one-tailed test, d.f. = 65, \( r_s = -0.205, P = 0.048 \)). There was no significant correlation between the owner’s opinion and the difference in dogs’ ages (Spearman’s rank correlation, \( P > 0.20 \)).

Cases in which owners were unable to predict which situations elicited fighting in the home (Fig. 3) had a poorer outcome than those in which aggression was more predictable (Mann–Whitney U-test: dog’s behavior \( n = 61 \), \( z = -2.25, P = 0.012 \); owner’s opinion \( n = 66 \), \( z = -2.16, P = 0.015 \)). However, for both household and non-household aggression there were no associations between intensity or frequency of fighting and outcome (both measures, Spearman’s rank correlation, \( P > 0.15 \)). Whether dogs could be together without fighting prior to treatment did not affect either measure of outcome in cases of household aggression (Mann–Whitney U-test, \( P > 0.10 \)). Household cases in which a person was bitten during a fight had a poorer outcome, measured by the dog’s behavior, than those in which no one had been bitten (Mann–Whitney U-test, dog’s behavior \( n = 61 \), \( z = -2.90, P = 0.002 \); owner’s opinion \( P > 0.10 \)).
4. Discussion

4.1. Household and non-household aggression

Many aspects of this study indicated that aggression between dogs living together occurred when a dominant–subordinate relationship was contested. We have confirmed what other studies have suggested: that dominance conflicts usually occur between dogs of the same sex (Campbell, 1975; Borchelt and Voith, 1982; Borchelt, 1983; Overall, 1993b), especially between females (Hart and Hart, 1985). In this study more females than males started fights, and almost 50% of fighting pairs involved two females (Fig. 2). Polsky (1983) reported that most dogs he treated for aggression in the home were pairs of females; pairs of males, and females that attacked males were much less common, and there were no cases in which a male attacked a female. In the present study, fights between females tended to be more injurious than fights between males or opposite-sex pairs, as were fights between housemates compared to fights between non-household dogs. Campbell (1975) and Polsky (1983) also noted that fights between dogs living together usually were severe.

Dogs that fought with housemates sometimes exhibited behaviors associated with establishing dominance (Fig. 3; mounting, standing over, blocking, staring, and standing in a stiff, erect posture), and they were more likely to house soil or mark (Table 2), again suggesting attempts to assert dominance. Dominance is generally associated with length of residence in the home and larger size (Hart and Hart, 1985), and may be contested when dogs are similar in size and age (Dunbar and Bohnenkamp, 1985). Household fighting may begin when a younger dog challenges an aging dog (Beaver, 1983; Hart and Hart, 1985), when an older dominant dog is supplanted by a younger, larger dog, or when a larger adult dog is brought into the home (Hart and Hart, 1985). In this study the dog that started fights was a younger, newer member of the home in nearly 60% of cases, suggesting that the dominance of an established dog was being challenged. About half the dogs that fought were of the same breed, and thus similar in size and weight. When different breeds or sizes were involved, the larger dog started fights in 85% of cases. Fights between siblings may occur because they are similar in size and age, and still competing for rank in the litter (Campbell, 1975, p. 203). When a parent and offspring of the same sex live together, the son or daughter may eventually challenge its parent’s dominance.

Triggers of household aggression in the present study were similar to those described in earlier reports (Campbell, 1975; Borchelt and Voith, 1982; Polsky, 1983; Hart and Hart, 1985). The presence of an owner is a frequent trigger (Campbell, 1975; Hart and Hart, 1985); such dogs may be fighting over the owner’s attention, or perhaps because the rank of the subordinate dog is raised by proximity to the owner (Beaver, 1983; Hart and Hart, 1985). However, dogs also fight when owners are absent (this study; Voith, 1980), and may be seriously injured or even killed in the owner’s absence (Borchelt and Voith, 1985). Aggression in a confined space such as a hall or doorway may occur because the subordinate dog approaches the dominant dog too closely or in a challenging manner.

Aggression toward dogs that were not members of the household was the second context of intraspecific aggression in this study. These dogs appeared to exhibit
territorial aggression as they defended a specific location or the owner (Borchelt, 1983) from dogs that were not members of their family. Attacked dogs were usually unfamiliar, and some owners felt their dogs were less aggressive when away from their home territory. Males more often exhibited this type of aggression, and initiating dogs were more aggressive toward other males in 38% of cases in which the sexes of target dogs were known.

Compared with dogs fighting with housemates, dogs that were territorially aggressive were more likely to have a history of predatory behavior. Hart and Hart (1985, p. 49) suggested that some attacks by larger dogs on smaller dogs may be predatory; however, descriptions of the dogs' behavior prior to attacking would be required to assess the likelihood of this possibility. In the present study, dogs that attacked non-household dogs also tended to be both dominant-aggressive toward their owners and difficult to control. Similarly, Campbell (1975) reported that dogs that attacked unfamiliar dogs “... are dominant in their relationships with their owners” (p. 203; but see Voith, 1980; Hart and Hart, 1985).

In this study, cases in which the owner's primary concern was household aggression were nearly three times as numerous as cases of aggression toward non-household dogs. A similar preponderance of household aggression (86%, 12/14 cases) was found in an earlier study at the ABC (Houpt, 1983). The frequency of household aggression at two referral clinics was 71% (10/14 cases) and 50% (5/10 cases; Landsberg, 1991; Cornell data were not included because of overlap with the present study).

The results of comparisons to combined AKC registrations in 1983, 1988, and 1993 suggested that some breeds and groups of breeds were more likely to exhibit intraspecific aggression than others. The greater number of herding breeds among cases of household aggression was probably due to the relatively large number of German Shepherd Dogs in our cases. Scott and Fuller (1965) suggested that herding dogs, especially shepherds, were selected to guard against predators and therefore tended to be more aggressive than other breeds. No toy breeds were treated for fighting at the ABC, and they were less numerous than expected among cases of household aggression. Owners of toy breeds that fought may have been less likely to consult the ABC than owners of larger breeds in which fighting was more dangerous. Sporting breeds were also less frequently represented among our cases than expected. Scott and Fuller (1965) suggested that hunting breeds displayed less agonistic behavior because of selection for bite inhibition and the ability to live peacefully in groups. Terriers were more numerous than expected among cases of non-household, but not household aggression, suggesting that their reputation for aggressiveness toward dogs (Scott and Fuller, 1965) may be due mostly to behavior directed toward non-household dogs.

Although individuals of some breeds or groups of breeds may be more likely to attack other dogs, the variety of breeds treated for the problem in this study and others (Campbell, 1975; Borchelt, 1983; Landsberg, 1991) indicates that aggression toward dogs occurs in many pure and mixed breeds.

4.2. Comparisons with wolves

Because the wolf (C. lupus) is the ancestor of the domestic dog (Morey, 1994), and aggressive behavior problems in dogs largely parallel the systems of aggression shown
by wolves (Borchelt, 1983), comparisons between domestic dogs and wolves may enrich our understanding of aggression between dogs.

The behaviors associated with dominance conflicts in wolf packs are similar to the behaviors of dogs that fight with housemates, supporting our hypothesis that fights between dogs in a home are rooted in dominance disputes. Among wolves, males and females usually have separate dominance hierarchies (Mech, 1970; Zimen, 1982), although the alpha male and female may dominate adults of the opposite sex (Mech, 1970), and opposite-sex wolves may have dominance interactions when they are very different in rank or age (Zimen, 1982). In one study of a captive wolf pack, aggression was more often initiated by females than males (62% of 1558 interactions), and more than half the interactions (57%) involved two females (Fentress et al., 1987). These data are similar to our findings that more females started fights (Fig. 2(a)) and that F-F pairs were most frequently observed (Fig. 2(b)). As in dogs, fights between female wolves usually lead to more serious injuries than fights between males or opposite-sex wolves (Zimen, 1976; Zimen, 1982; Fentress et al., 1987), with females displaying less bite inhibition and fewer preliminary threats (Zimen, 1976).

Maturing juvenile and subordinate adult wolves continuously test the dominance of older wolves; older (Zimen, 1982), larger (Lockwood, 1979) individuals are usually more dominant. Similarly, younger, larger dogs tended to initiate aggression in our study. The death or infirmity of an alpha wolf results in fighting and dominance shifts among pack members (Mech, 1970; Zimen, 1976); likewise, increased household aggression accompanied the aging of a dominant dog.

Triggers of household aggression in dogs have parallels in wolf social behavior. Aggression may occur over food or during 'group rallies', when a wolf is greeted as it returns to the pack, or when the pack becomes aroused before hunting (Fentress et al., 1987). Playful interactions, which often involve dominance testing, may escalate to fighting (Zimen, 1982; Fentress et al., 1987). During group attacks, uninvolved wolves join fights that began between two individuals, and also attack the lower ranking animal (Zimen, 1976; Fentress et al., 1987). This behavior may be similar to the facilitated aggression we observed, in which the dog that usually initiated aggression attacked the target dog when the owner punished the target dog. Aggression among female wolves increases with the onset of the breeding season (Mech, 1970; Allen, 1979; Zimen, 1976; Zimen, 1982; Fentress et al., 1987). As in dogs, the dominant female attacks subordinate females that come into estrus and breed; such females may be temporarily driven out of the pack, or severely injured or killed in captive packs (Zimen, 1976; Zimen, 1982; Fentress et al., 1987).

Territorial defense in wolves is similar to the non-household aggression of dogs described in this study. Wolves chase and sometimes kill strangers or members of nearby packs (of either sex) that enter their territory (Mech, 1970; Allen, 1979; Mech, 1993). The alpha male is especially threatening (Mech, 1970; Mech, 1993), although the alpha female also attacks strangers (Mech, 1993). In a captive colony, the alpha pair was aggressive toward tame wolves that were brought near their compound, whereas subordinate and formerly-alpha wolves behaved submissively (Zimen, 1976; Zimen, 1982). The alpha pair exclusively (Zimen, 1976; Allen, 1979; Mertl-Millhollen et al.,
1986), or most frequently (Lockwood, 1979) marks the pack's territorial boundary with raised-leg urinations.

4.3. Classification of aggression between dogs

Various classifications of aggression between dogs have been used by behaviorists. Campbell (1975, p. 200) indicated that dog fights were either ‘..relative to..territorial boundaries or property..’, or ‘sibling-type’, between members of the same household. Hart and Hart (1985, p. 49) stated that the two main causes of fighting were ‘.. failure..to establish or maintain a...dominant–subordinate relationship’, and ‘...the innate tendency of dogs, particularly strangers, to pick fights with members of their own sex’.

Other investigators have characterized dog fighting as intermale (Voith, 1980; Beaver, 1983), or used the categories of intermale and interfemale proposed by Borchelt and Voith (1982), Borchelt (1983) and Borchelt and Voith (1985).

The results of this study and comparisons with wolves indicate that aggression between dogs occurs in two main contexts: dominance conflicts within the home, and territorial defense toward dogs that are not members of the family pack. We found underlying differences in the characteristics of these two groups, and suggest that a target-based classification better reflects the contexts and evolutionary functions of intraspecific aggression. A target-based system provides behaviorists with an objective, diagnostic classification for aggression among dogs, recognizes that aggression also occurs between females, and eliminates the problem of how to classify dogs that fight with opposite sex individuals (Beaver, 1983; Borchelt, 1983). Cases can be grouped either by presenting complaint, or by whether a dog is sometimes aggressive in both contexts.

4.4. Treatment recommendations

At the ABC, 50 of 87 (58%) household and non-household aggression cases improved after treatment. This is a lower success rate than that reported by Beaver (1983) and Houpt (1983). The difficulty of treating aggression between dogs has been noted by other behaviorists (Campbell, 1975; Polsky, 1983).

Treatments suggested by the ABC for intraspecific aggression were similar to those described in the literature (Campbell, 1975; Hart, 1976; Hopkins et al., 1976; Voith, 1980; Hart, 1981; Borchelt and Voith, 1982; Beaver, 1983; Borchelt, 1983; Mugford, 1984; Hart and Hart, 1985). Weighing the effects of each treatment was difficult for several reasons. We did not attempt to discover how effectively each client used each treatment, nor could we identify inaccuracies in the memory of which treatments were applied. Also, there were too many combinations of treatments to permit a multifactorial analysis. Finally, some treatments changed during the 10 years spanning this study. For example, the head halter (Gentle Leader*–Promise*) was not available until 1986, and obedience training methods began to emphasize positive rather than negative reinforcement.

Desensitization and counterconditioning are recommended to treat both types of intraspecific aggression (Campbell, 1975; Voith, 1980; Borchelt and Voith, 1982; Hart
and Hart, 1985; Overall, 1993c). However, low compliance by owners in this study suggested that these procedures were difficult to apply. In many cases, treatment follow-ups were made by telephone. To improve the efficacy of desensitization and counterconditioning, live follow-ups should be made frequently throughout the treatment period.

The results of this study and information on the social behavior of wolves provide insights that may lead to improvements in treatments. To prevent household aggression, owners should be advised not to acquire a second female, particularly one of a larger breed than the resident female. If a younger female joins a household with an older, resident female, owners should be urged to neuter the younger female before its first estrus. For existing problems of household fighting, obedience training, although necessary for desensitization, may not provide control once dogs have begun to fight. Furthermore, the high level of aggression among subordinate wolves (Zimen, 1982) suggests that the effect of obedience training in establishing the owner as pack leader may not reduce household aggression. It may be more important for behaviorists to observe the dogs in the home, help owners to identify the more dominant dog, and explain how to treat the dogs consistently in ways appropriate to their relative ranks. Alternatively, when dogs that fight are similar in age and size and neither is likely to maintain a higher rank, owners may be more successful if they reduce the privileges (and thus ranks) of both dogs, correcting any aggression by either dog.

In contrast, non-household aggression tended to be associated with dominance aggression toward owners and out of control behavior in this study, perhaps indicating a lack of human leadership in the family pack. We suggest that dominance-reversing exercises such as withholding attention until the dog complies with a command, reducing privileges, and obedience training with a head halter should be encouraged. To further reduce the dog’s status and non-household aggression, these dogs should not be permitted to perform the alpha wolf behavior of marking territorial boundaries during walks. Instead, they should relieve themselves in the immediate vicinity of their homes before being walked off their property (see also Campbell, 1975).

In summary, we suggest that aggression between dogs occurs in two contexts that largely parallel social aggression in wolves. An analysis of the problem of dogs that fight with housemates and outsiders within this framework can increase our understanding of the causes of the behavior and the treatments that are most likely to be successful.

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