

1 Factors associated with dog behavior problems referred to a behavior clinic

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1 **Abstract**

2 Undesirable behaviors are common in the domestic dog population. This study aimed at
3 characterizing similarities and differences in characteristics underlying two major groups of
4 behavior problems, and their treatment outcome. The study focused on 335 dogs that visited a
5 Behavioral Clinic in northern Italy between 2013-2016. These cases were categorized into 2 groups
6 based on the diagnosis: an aggressive group included behavioral pathologies involving aggressions,
7 and an anxious group including dogs with behavioral pathologies not primarily involving
8 aggression. Each dog underwent to a behavior consultation made by a veterinary specialist that used
9 a basic history questionnaire focused on all aspect of dog's behavior, management and health issue.
10 Several variables were selected from the questionnaires collected. We found a statistical association
11 of the behavior problem with factors such as size, sex, age, time of onset, dogs' resting place,
12 family composition and mounting behaviors involving people ($p \leq 0.05$). Small and medium sized
13 dogs were mainly anxious instead of aggressive; male dogs were mostly aggressive and female
14 dogs (neutered and intact) were mainly anxious; dogs adopted from pet shop were all anxious. On
15 average, aggressive dogs exhibited the problem 4 months after adoption. Anxious dogs exhibited
16 the problem one week after adoption. The resting place and diagnosis were statistically related ($p \leq$
17 0.05): the 20% of dogs that slept on owners' bed were mainly anxious dogs (78%) whereas
18 aggressive dogs (22%); regarding the other resting post the percentage of anxious or aggressive
19 dogs were similar. Sixty-five per cent of anxious dogs and 33% of aggressive ones showed
20 mounting behaviors towards people. Most (72.3%) (N=242/335) of the dogs improved after
21 behavior treatment. Aggressive dogs (96%, N= 232/242) improved more than anxious ones (4%; N
22 = 10/242) ($p \leq 0.05$). Moreover, owners of dogs with anxiety problems were significantly more
23 prone to surrender the dog to a shelter or other people ($p \leq 0.05$). Our work supports some previous
24 findings and suggests some new information regarding factors associated with aggression and
25 anxiety in domestic dogs. Anxiety problems appear more difficult and demanding for dog owners.
26 A referral population is not likely representative of the entire population of dogs. To understand
27 patterns of behavioral problems, we need more complete population data and we need data from
28 dogs across their lifetime.

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Keywords: aggression, anxiety, problems behavior, dogs

1 **Introduction**

2 Undesirable behaviors are common problems in the domestic dog population. So-called behavioral
3 problems are risk factors for relinquishment of dogs to an animal shelter (Patronek et al., 1996).

4 Dog bites to humans are a complex problem for public health (Weiss et al., 1998), and have a media
5 focus and negative social effect. Some behavior pathologies, such as separation anxiety, pose
6 problems in the field of animal welfare (Horwitz, 2002).

7 Understanding the epidemiology of these problems is an essential key to establish treatment and
8 prevention programs. In the United States, 40% of the dog and cat population have been estimated
9 to have behavioral problems (Voith, 1985). Other studies in the US have suggested a prevalence
10 rate as high as 87% for dogs (Campbell, 1986). In the United Kingdom or Australia (Adams and
11 Clark, 1989; O'Farrell, 1992), about 80% of dogs exhibit undesirable behaviors. In Denmark, 29%
12 of the dogs show these kinds of problems, despite the fact that only 4 behaviors were analyzed:
13 'dominance' toward the owner, inter-dog aggression, separation anxiety, and shooting phobia
14 (Rugbjerg et al., 2003).

15 Several studies show that aggression is the most frequent behavior pathology in dogs (Voith, 1985;
16 Knol, 1987; Wright and Nesselrote, 1987; Landsberg, 1991; Hsu and Serpell, 2003; Bamberger and
17 Houpt, 2006; Yalcin and Batmaz, 2007). Other frequent behavioral problems reported include
18 inappropriate elimination (Voith, 1985; Landsberg, 1991) or different anxieties, such as separation
19 anxiety disorder (Hsu and Serpell, 2003; Bamberger and Houpt, 2006; Yalcin and Batmaz, 2007).
20 Dogs show generally more than one behavior problem (Campbell, 1986; Adams and Clark, 1989;
21 Overall et al., 2001; Overall and Dunham, 2002; Hsu and Serpell, 2003; Bamberger and Houpt,
22 2006; Fatjó et al., 2006; Yalcin and Batmaz, 2007). One of the main reasons dogs are given away,
23 abandoned, or euthanized is a behavior problem.

24 With the accumulation of the treatment experience for behavior problems, many behaviourists
25 (veterinary surgeon specialized in behavior therapy) have started to characterize these behavior
26 problems using retrospective techniques. Most studies have determined whether or not there were
27 breed, sex, age or experiential risk factors for a given behavior problem (Borchelt, 1983; Line and
28 Voith, 1986; Wright and Nesselrote, 1987; Blackshaw, 1991; Landsberg, 1991; McCrave, 1991;
29 Clark and Boyer, 1993; Serpell and Jagoe, 1995; Lund et al., 1996; Galac and Knol, 1997; Neilson
30 et al., 1997).

31 There is considerable variation among studies about the most common behavior problems and the
32 influence certain risk factors for these behaviors (Martinez et al., 2011).

1 This study sought to characterize similarities and differences in characteristics for two major groups
2 of behavior problems, and their treatment outcome. The two groups were created based on
3 phenotypic/phenomenological diagnosis: behavioral pathologies not primarily involving aggression
4 and behavioral pathologies involving aggressions (Moyer, 1968; Overall, 1997; Overall, 2005;
5 Overall, 2013). This diagnostic criteria relies on behaviors exhibited by dogs within specific
6 contexts (Overall, 2013).

7 **Materials and methods**

8 **Subjects**

9 All behavioral case records for 335 dogs that were diagnosed with separation-related problems
10 and/or aggression at a Behavioral Clinic in northern Italy between 2013-2016 were included in this
11 study.

12 These cases were categorized into 2 groups based on the diagnosis: an *aggressive group* (150
13 subjects) which included different forms of aggression (maternal aggression, play aggression, fear
14 aggression, pain aggression, territorial aggression, protective aggression, inter-dog aggression,
15 redirected aggression, food-related aggression, possessive aggression, predatory aggression,
16 impulse-control aggression, idiopathic aggression) and an *anxious group* (185 subjects) which
17 included dogs with behavioral pathologies not primarily involving aggression, including
18 generalized anxiety, separation anxiety, different forms of fear and phobia, (Horwitz, 2009; Levine,
19 2009; Luescher, 2009; Overall, 2013; Palestrini, 2009).

20 Each dog underwent to a behavior consultation made by a veterinary specialist (always the same
21 person) that used a basic history questionnaire focused on all aspect of dog's behavior, management
22 and health issue. Several variables of the dog's characteristics and history as well as on the physical
23 and social environment of the dogs were selected from the questionnaires collected.

24 Home environment, management, age (current, age at acquisition), sex, reproductive status (entire
25 or neutered/spayed), breed, number of adults and children in the household (children older than 18
26 years were considered adults), source of dog (breeder, pet store, shelter, rescue, family, friends or
27 stray), and number of dogs and cats in the household, dog's behavior during owner absence and
28 aggressive behavior were also considered in the study.

29 **Statistical analysis**

30 Client responses to the questionnaire about behavior, anamnesis, management data (like number of
31 family members, source of dog, etc) were scored and their absolute and relative frequencies were
32 calculated and expressed as percentage. Chi-square test was used to identify differences in
33 characteristics shown by dogs diagnosed with separation anxiety and with aggression. Differences
34 were considered to be statistically significant if $p \leq 0.05$.

1 **Results**

2 Of all the dogs involved in the study, 44.8% (N=150/335) had a diagnosis involving aggression and
3 55.2% (N=185/335) had a diagnosis involving anxiety without aggression. Within the anxious
4 group 19.1% (N=64/335) had separation anxiety, alone, 36.1% (N=121/335) a mixed diagnosis of
5 separation anxiety and other problem behaviors (i.e., generalized anxiety and fears/phobias). In the
6 aggressive group, 19.1% (N=64/335) fear aggression and 25.7% (N=86/335) other form of
7 aggressions (i.e. maternal, inter-dog, idiopathic, status related, etc.). Dogs exhibiting inter-dog
8 aggression and status related aggression could also be anxious, but we decided to enhance the
9 aggressive behavior and to gather these categories.

10 Mixed breed dogs comprised 41.2% (N=138/335) of our sample and pure breeds 58.8%
11 (N=197/335). Of dogs with a diagnosis of aggression, 42.7% (N=64/150) were mixed breed dogs
12 and 57.3% (N=86/150) pure breeds. Similar percentages were found for anxiety diagnosis: 40%
13 (N=74/185) was mixed breed dogs and 60% (N=111/185) was pure breed dogs. The breeds were
14 divided into groups according to the Official Dog Breeds List of the Italian Kennel Club:
15 Sheepdogs and Cattle dogs (1), Pinschers, Schnauzers and Molossers (2), Terriers (3), Dachshunds
16 (4), Spitz and primitive type dogs (5), Hounds and blood tracking dogs (6), Pointing dogs (7),
17 Retrievers, search dogs, water dogs (8), Companion dogs (9), Greyhounds (10). Two additional
18 groups were added: Pit Bulls (11) and Mixed breed (12). Table 1 describes the distribution of the
19 breeds in the two groups of diagnosis.

20 In our sample, 46.2% (N=155/335) were medium sized dogs, 27.4% (N=90/335) large dogs, and
21 27.4% (N=90/335) small dogs. The size of dogs was established on weight: small: < 11 kg,
22 medium: from 11 to 30 kg, and large: > 30 kg (Dorn et al., 2017).

23 We found a significant association between the dogs' size and the diagnosis ($p \leq 0.05$): small dogs
24 were for 72.3% (N=65/90) anxious and for 27.7% (N=25/90) aggressive; medium dogs were 64%
25 (N=99/155) anxious and 36% (N=56/155) aggressive; large dogs were more frequently in the
26 aggressive category (60%-N=54/90) instead of in the anxious one (40%-N=36/90).

27 Most of the dogs were intact males (50.7%-N=170/335), 11% (N=37/335) were neutered males,
28 16.7% (N=56/335) were intact females and 21.5% (N=72/335) were neutered females. There was a
29 statistically significance effect of sex for the diagnostic groups ($p \leq 0.05$). Figure 1 shows that
30 neutered males were mainly aggressive and female (neutered and intact) were mainly anxious.
31 Intact male were found in both diagnostic groups approximately equally (46%, N=79/170
32 aggressive and 54%, N=91/170 anxious).

1 Most dogs referred to the clinic were 13 months - 4 years (56.1% of dogs, N=188/335). Age of the
2 dog and diagnosis were statistically related ($p \leq 0.05$): dogs aged less than 1 year were mostly
3 anxious (about 75%, N=12/16).

4 We found a statistical association between diagnosis and source of adoption ($p \leq 0.05$). Twenty-
5 eight per cent of the dogs (N=94/335) was adopted directly from breeders, 22% (N=74/335) were
6 acquired from a pet store, 21% (N=70/335) from animal shelters, 19% (N=64/335) from another
7 person, and the remaining dogs (10%, N=33/335) were strays. Dogs adopted from another person
8 were mainly aggressive (97%, N=62/64) dogs came from pet stores were all anxious and the ones
9 from shelters or stray were a little bit more in the anxious group.

10 No statistical differences in diagnosis were seen regarding the age of adoption: 47% of dogs
11 (N=157/335) were adopted between 51 days and three months of age, 36.2% (N=121/335) after
12 three months and 16.8% (N=57/335) before 51 days.

13 The time of onset of the problem was associated with diagnosis ($p \leq 0.05$). In particular, dogs that
14 presented the problem approximately one week after adoption were mainly anxious (84%,
15 N=98/117), as opposed to dogs that exhibited the problem about 4 months after adoption that were
16 mainly aggressive (61%, N=37/61) (figure 2).

17 We found a statistical association between family composition and diagnosis ($p \leq 0.05$). Dogs that
18 with lived with singles (75%, N=36/49) and with couples (65%, N=81/125) were more frequently in
19 the anxious category instead of in aggression one. The percentages of dogs with different type of
20 diagnosis living in household with children were similar: anxiety 54% (N=73/136) and aggression
21 46% (N=63/136).

22 About 50% (N=160/335) of dogs had a dog basket, 14.3% used the sofa (N=48/335) and 20.6%
23 (N=69/335) slept on owner's bed. The resting place and diagnosis were statistically related ($p \leq$
24 0.05): the dogs that slept on owners' bed were mainly anxious dogs (78%) (N=54/69) whereas
25 aggressive dogs (22%) (N=15/69); regarding the other resting post the percentage of anxious or
26 aggressive dogs were similar (figure 3).

27 Mounting behavior involving people was seen in 24.8% (N=83/335) of the subjects. Of these, 67%
28 (N=56/83) were anxious and 33% (N=27/83) aggressive ($p \leq 0.05$). No differences were seen in
29 mounting behavior towards other dogs between the aggressive and non-aggressive groups.

30 Most (72.3%) (N=242/335) of the dogs improved after behavior treatment. Aggressive dogs (96%,
31 N= 232/242) improved more than anxious ones (4%; N = 10/242) ($p \leq 0.05$).

1 The number of visits for each patient and the use of pharmacology were associated with the
2 diagnosis ($p \leq 0.05$). In particular, dogs that had 2 visits were 67% (N=32/48) anxious and 33%
3 (N=16/48) aggressive whereas those who had 3 visits were 100% anxious (N=24/24) (figure 4).
4 Pharmacological therapy was given to 72% (N=140/194) of dogs with anxiety and to 28%
5 (N=54/194) of dogs with aggression (figure 5).
6 Owners of dogs with anxiety problems were significantly more inclined to (65%) (N=34/52) to
7 surrender the dog to a shelter or to other people than were owners of dogs with aggression problems
8 (35%, N=18/52) ($p \leq 0.05$)

9 **Discussion**

10 Dogs exhibit a range of behaviors related to their emotional state (Beaver, 1982). Behaviors are
11 influenced by three main factors not independent one from each other: genetics, experience and
12 environment (Gottesman and Hanson, 2005). Behavior problems in companion animals present
13 serious public, health, economic and animal welfare concerns (Col et al., 2016). The aim of this
14 study was to evaluate possible factors that may correlate with a specific diagnosis of anxiety or
15 aggression. Aggression is the most frequent behavior problems in dogs (Voith, 1985; Knol, 1987;
16 Wright and Nesselroete, 1987; Landsberg, 1991; Hsu and Serpell, 2003; Bamberger and Houpt,
17 2006; Yalcin and Batmaz, 2007). Other recurrent behavioral problems include inappropriate
18 elimination (Voith, 1985; Landsberg, 1991) and various anxieties, such as separation anxiety
19 disorder (Overall et al., 2001; Bamberger and Houpt, 2006; Yalcin and Batmaz, 2007, Palestirini et
20 al., 2010; Blackwell et al., 2013).
21 No breed prevalence related to diagnosis was found in our study. Breed-associated risk for behavior
22 problems is associated with the breed distribution in the geographic area (Overall, 1997; Reisner et
23 al., 2005) and the popularity of the breed, but this apply for any risk, that must be calculated with
24 respect to the population (Svartberg, 2006).
25 In our sample, smaller sized dogs were over-represented in the anxiety group. A recent study found
26 a strong negative correlation between body-size and unwanted behaviors: smaller dogs had
27 significantly more compulsive behaviors, mounting behavior, separation-related problems, urine
28 marking, but most importantly, dog-directed fear, and non- social fear (McGreevy et al., 2013).
29 Martinez et al. (2011) reported that increasing body size was also related to a reduced emotion of
30 fear. Data showed by Martinez indicated that larger dogs were over-represented in their study in
31 aggression to people. Conversely, Tiira and Lohi (2015) found that the size of the dog may not be
32 a major factor for fearfulness.

1 In our study, neutered males were more in the aggressive category than the anxious one. Castration
2 has been reported to decrease aggression to other dogs in 62% of cases (Hopkins et al., 1976), but
3 there are no data on true effects on problematic behaviors or specific diagnosis (Overall, 2013).
4 Neuter/spay status (Messam et al., 2008) has been reported to have important relationships with dog
5 aggressiveness, which is observed to be lower in neutered/spayed individuals (Borchelt, 1983;
6 Gershman et al., 1994; Messam et al., 2008). Testosterone acts as a behavior modulator that makes
7 dogs react more intensely. When an intact dog decides to react, it reacts more quickly, with greater
8 intensity, and for a longer period of time (Overall and Love, 2001). Male dogs are more often
9 involved in dog bite episodes than females (Gershman et al., 1994; Cameron, 1997; Overall and
10 Love, 2001; Fatjo et al., 2007, Casey et al., 2014). In our sample, females more commonly had
11 anxiety disorders not involving aggression. There was no difference in the proportion of neutered
12 females and intact females with aggression diagnoses, which differs from other results showing that
13 aggression is more commonly observed in spayed females (Borchelt, 1983; Wright and Nesselrote,
14 1987; Wright 1991). Guy et al. (2001) found that in the population they studied, both neutered
15 males and spayed females were more common than intact dogs when considering aggression, a
16 result that differed from the population Blackshaw (1991) studied. There are no good population-
17 level data on effects of sex and aggression that controls for potentially confounding factors like
18 reasons for neutering (Overall, 2013; Casey et al., 2014).

19 Female dogs have been found to have more phobias (Bamberger and Houpt, 2006) and a higher
20 demand for affection (Bradshaw et al., 1996), while certain immature behaviors and inappropriate
21 elimination were more common in males (Landsberg, 1991).

22 We found that dogs less than 1 year most commonly had diagnoses involving anxiety. Dogs older
23 than 1 year showed a similar percentage of aggression and anxiety. We found that aggressive dogs
24 were reported to begin to exhibit aggression 4 months after adoption and anxious ones showed the
25 behavior within a week of adoption.

26 We found no differences in diagnosis regarding the age of adoption.

27 Source of acquisition may affect behavior problems (Hsu and Sun, 2010). Our results showed that
28 all 74 dogs acquired from a pet store had a diagnosis of anxiety. Dogs from pet stores have been
29 shown to be over-represented for some behavioral conditions (Pierantoni et al., 2011; McMillan,
30 2017). Because of how dogs sold through pet stores and/or born in commercial breeding
31 establishments are bred, housed, weaned, transported, handled, homed, and raised, potential
32 contributing factors for these reported outcomes are numerous (McMillan, 2017).

1 The majority of dogs adopted from shelters and the majority of stray dogs in this study were
2 diagnosed with anxiety, whereas dogs adopted from another person were mainly diagnosed with
3 aggression.

4 We found that sleeping on the bed and mounting people were more prevalent in anxious dogs than
5 aggressive dogs.

6 We found that dogs that improved with the suggested treatment plan more often had diagnoses
7 involving aggression, rather than anxiety diagnoses that did not involve aggression. The suggested
8 treatment plan included a combination of the following four basic strategies: education and
9 modification of the client's behavior, changes to the patient's environment, changes of the patient's
10 behavior and pharmacological therapy. Behavioral protocols were kept as simple as possible to be
11 easily integrated into the owner's daily routine, clarifying owner-animal communication and
12 keeping to the application of the basic learning principles. General outcomes of the behavioral
13 treatments were based on the records of follow-up calls and on the follow-up visits 1-2 months after
14 the first visit by the veterinary behaviorist.

15 The number of visits as much as the administration of pharmacological therapy could be a diagnosis
16 or a condition effect, but also due to the clinician or owner decision. There are three factors, which
17 may not be independent, which could be involved in these points.

18 Although the number of visits could be due to other things than just the diagnosis, in our study
19 anxious dogs had more follow-up visits and were prescribed more with pharmacological therapy.
20 Moreover, owners of anxious dogs thought more to surrender their dog to other people. Anxiety
21 related problems, in particular separation anxiety represents one of the principal causes for the
22 breakdown of the human-companion animal bond and lead to surrender of numerous dogs to
23 shelters (Van der Borg et al., 1991; Houpt et al., 1996; Sherman and Mills, 2008; Diesel et al.,
24 2010; Sargisson, 2014).

25 **Conclusion**

1 Our work supports some previous findings that, in a referral population, more dogs with aggressive
2 diagnoses are male and dogs solely with anxiety-related diagnoses are mostly female, aged less than
3 a year and adopted from pet stores and suggest some new information regarding factors associated
4 with aggression and anxiety in domestic dogs.

5 It could be though that aggression is mentally and emotionally charged for human, but from these
6 results, anxiety problems appear more difficult and demanding for dog owners. Aggression is clear
7 and context dependent and most often you can control that context. Anxiety is diffused and
8 generalized and occurs in contexts that are less amenable to manipulation.

9 A referral population is not likely representative of the entire population of dogs. To understand
10 patterns of behavioral problems, we need more complete population data and we need data from
11 dogs across their lifetime.

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13 **Authorship statement**

14 The idea for the paper was conceived by Clara Palestrini. The experiments were designed by Simona
15 Cannas and Clara Palestrini. The experiments were performed by Zita Talamonti, Anna Picciolini
16 and Silvia Mazzola. The data were analyzed by Simona Cannas and Michela Minero. The paper
17 was written by Simona Cannas and Clara Palestrini.

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19 **Conflict of interest statement**

20 The authors of this paper do not have a financial or personal relationship with other people or
21 organizations that could inappropriately influence or bias the content of the paper.

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23 **References**

24 Adams, G.J., Clark, W.T., 1989. The prevalence of behavioural problems in domestic dogs; a
25 survey of 105 owners. *Aust. Vet. Pract.* 19, 135-137.

26 Bamberger, M., Houpt, K.A., 2006. Signalment factors, comorbidity, and trends in behaviour
27 diagnoses in dogs: 1,644 cases (1991-2001). *J. Am. Vet. Med. Assoc.* 229, 1591-1601.

28 Beaver, B. V., 1982. Distance –increasing postures of dogs. *Vet. Med. Small Anim. Clin.* 77, 1023-
29 1024

30 Blackshaw, J.K., 1991. An overview of types of aggressive behaviour in dogs and methods of

1 treatment. Appl. Anim. Behav. Sci. 30, 351-361.

2 Blackwell, E.J., Bradshaw, J.W.S., Casey, R.A. 2013. Fear responses to noises in domestic dogs:
3 Prevalence, risk factors and co-occurrence with other fear related behaviour. Appl Anim Behav Sci.
4 145: 15–25.

5 Borchelt, P., 1983. Aggressive-behavior of dogs kept as companion animals—classification and
6 influence of sex, reproductive status and breed. Appl. Anim. Ethol. 10, 45–61.

7 Bradshaw, J.W., Goodwin, D., Lea, A.M., Whitehead, S.L., 1996. A survey of the behavioural
8 characteristics of pure-bred dogs in the United Kingdom. Vet. Rec. 19, 465-468.

9 Cameron, D.B., 1997. Canine dominance-associated aggression: concepts, incidence, and treatment
10 in a private behavior practice. Appl. Anim. Behav. Sci. 52, 265–274.

11 Campbell, W.E., 1986. The prevalence of behaviour problems in American dogs. Mod. Vet. Pract.
12 67, 28-31.

13 Casey, R.A., Loftus, B., Bolster, C., Richards, G.J., Blackwell, E.J., 2014. Human directed
14 aggression in domestic dogs (*Canis familiaris*): Occurrence in different contexts and risk factors,
15 Appl Anim Behav Sci. 152, 52-63,

16 Clark, G.I., Boyer, W.N., 1993. The effects of dog obedience training and behavioural counselling
17 upon the human-canine relationship. Appl. Anim. Behav. Sci. 37, 147-159.

18 Col, R., Day, C., Phillips, C. J. C., 2016. An epidemiological analysis of dog behavior problems
19 presented to an Australian behavior clinic, with associated risk factors. Journal of Veterinary
20 Behavior. 15, 1-11.

21 Diesel, G., Brodbelt, D., Pfeiffer, D.U., 2010. Characteristics of relinquished dogs and their owners
22 at 14 rehoming centers in the United Kingdom. J Appl Anim Welf Sci. 13(1), 15–30.

23 Dorn, M. J., Bockstahler, B.A., Dupré, G.P., 2017. Influence of body weight and body conformation
24 on the pressure-volume curve during capnoperitoneum in dogs. A. J. V. R. 78 (5), pp 631-637.

25 Fatjo, J., Amat, M., Mariotti, V.M., de la Torre, J.L.R., Manteca, X., 2007. Analysis of 1040 cases
26 of canine aggression in a referral practice in Spain. J. Vet. Behav.-Clin. Appl. Res. 2, 158–165.

27 Galac, S., Knol, B.W., 1997. Fear-motivated aggression in dogs: patient characteristics, diagnosis
28 and therapy. Anim. Welf. 6, 9-15.

29 Gershman, K., Sacks, J., Wright, J., 1994. Which dogs bite—a case-control study of risk-factors.
30 Pediatrics 93, 913–917.

1 Gottesman, I. I., Hanson, D. R., 2005. Human development: Biological and Genetic Processes.
2 *Annu. Rev. Psychol.* 56, 263–86.

3 Guy, N.C., Luescher, U.A., Dohoo, S.E., Spangler, E., Miller, J.B., Dohoo, I.R., Bate, L.A., 2001.
4 Demographic and aggressive characteristics of dogs in a general veterinary caseload. *Appl. Anim.*
5 *Behav. Sci.* 74, 15-28

6 Hopkins, S. G., Schubert, T. A., Hart, B. L., 1976. Castration of adult male dogs: effects on
7 roaming, aggression, urine marking, and mounting. *J Am Vet Med Assoc.* 168 (12), 1108-1110.

8 Horwitz, D.F., 2002. Separation-related problems in dogs. In: Horwitz, D., Mills, D., Heath, S.
9 (Eds.), *BSAVA Manual of Canine and Feline Behavioural Medicine*. British Small Animal
10 Veterinary Association, Gloucester, UK, pp. 154-163.

11 Horwitz D.F., 2009. Separation-related problems in dogs and cats. In: Horwitz, D., Mills, D. (Eds.),
12 *BSAVA Manual of Canine and Feline Behavioural Medicine*. Second Edition. British Small
13 Animal Veterinary Association, Gloucester, UK, pp. 146-158.

14 Houpt, K.A., Honig, S.U, Reisner, I.R., 1996. Breaking the human-companion animal bond. *J Am*
15 *Vet Med Assoc.* 208, 1653–1659

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

18 Hsu, Y., Sun ,L., 2010. Factors associated with aggressive responses in pet dogs. *Appl. Anim.*
19 *Behav. Sci.* 123, 108-123

20 Knol, B.W., 1987. Behavioural problems in dogs. Problems, diagnoses, therapeutic measures and
21 results in 133 patients. *Vet. Q.* 3, 226-234.

22 Landsberg, G.M., 1991. The distribution of canine behaviour cases at three behaviour referral
23 practices. *Vet. Med.* 86, 1081-1089

24 Levine E. D., 2009. Sound sensitivities. In: Horwitz, D., Mills, D. (Eds.), *BSAVA Manual of*
25 *Canine and Feline Behavioural Medicine*. Second Edition. British Small Animal Veterinary
26 Association, Gloucester, UK, pp. 159-168.

27 Line, S., Voith, V.L., 1986. Dominance aggression of dogs towards people: behavior profile and
28 response to treatment. *Appl. Anim. Behav. Sci.* 16, 77-83.

29 Luescher A.U., 2009. Repetitive and compulsive behaviour in dogs and cats. In: Horwitz, D., Mills,
30 D. (Eds.), *BSAVA Manual of Canine and Feline Behavioural Medicine*. Second Edition. British

1 Small Animal Veterinary Association, Gloucester, UK, pp. 236-244.

2 Lund, J.D., Agger, J.F., Vestergaard, K.S., 1996. Reported behaviour problems in pet dogs in
3 Denmark: age distribution and influence of breed and gender. *Prev. Vet. Med.* 28, 33-48.

4 Martinez, A. G., Pernasa, G. S., Casalta, J. D., Rey, M. L. S., De la Cruz Palomino, L., F., 2011.
5 Risk factors associated with behavioral problems in dogs. *J. Vet. Behav.: Clin. Appl. Res.* 6, 225-
6 231

7 McCrave, E.A., 1991. Diagnostic criteria for separation anxiety in the dog. *Vet Clin North Am*
8 *Small Anim Pract Behav.* 21 (2), 247–255.

9 McGreevy, P.D., Georgevsky, D., Carrasco, J., Valenzuela, M., Duffy, D.L., Serpell, J.A. 2013.
10 Dog Behavior Co-Varies with Height, Bodyweight and Skull Shape. *PLoS ONE* 8: 1–7.

11 McMillan, F.D., 2017. Behavioral and psychological outcomes for dogs sold as puppies through pet
12 stores and/or born in commercial breeding establishments: Current knowledge and putative causes.
13 *J. Vet. Behav.: Clin. Appl. Res.* 19, 14-16

14 Messam, L.L.M., Kass, P.H., Chomel, B.B., Hart, L.A., 2008. The human– canine environment: a
15 risk factor for non-play bites? *Vet. J.* 177, 205– 215

16 Moyer, K.E., 1968. Kinds of aggression and their physiological basis. *Communications in*
17 *Behavioral Biology* 2, 65-87.

18 Neilson, J.C., Eckstein, R.A., Hart, B.L., 1997. Effect of castration on problem behaviors in male
19 dogs with reference to age and duration of behavior. *J.A.V.M.A.* 211, 180-182.

20 O’Farrell, V., 1992. Introduction. In: O’Farrell, V. (Ed.), *Manual of Canine Behaviour*. British
21 Small Animal Veterinary Association, Gloucester, UK, pp. 11-14.

22 Overall, K. L., 1997. Clinical behavioral medicine for small animals. St Louis: Mosby Year Book
23 Inc, pp 5–8, 209–250, 323–343, 393–400, 457–458

24 Overall, K.L., Dunham, A.E., Frank, D., 2001. Frequency of nonspecific clinical signs in dogs with
25 separation anxiety, thunderstorm phobia, and noise phobia, alone or in combination. *J. Am. Vet.*
26 *Med. Assoc.* 219, 467-473.

27 Overall, K.L., Love, M.J., 2001. Dog bites to humans-demography, epidemiology, injury, and risk.
28 *Am Vet Med Assoc.* 218(12), 1923-34.

29 Overall K.L., Dunham, A.E., 2002. Clinical features and outcome in dogs and cats with obsessive-
30 compulsive disorder: 126 cases (1989-2000). *J. Am. Vet. Med. Assoc.* 221(10), 1445-52.

1 Overall K.L., 2005. Veterinary behavioural medicine: a roadmap for the 21^o century. The
2 Veterinary Journal 169, 130-143

3 Overall, K. L., 2013. Manual of clinical behavioral medicine for dogs and cats. Elsevier, MO

4 Palestrini, C., 2009. Situational sensitivities. In: Horwitz, D., Mills, D., (Eds.), BSAVA Manual of
5 Canine and Feline Behavioural Medicine. Second Edition. British Small Animal Veterinary
6 Association, Gloucester, UK, pp. 169-181.

7 Palestrini, C, Minero, M, Cannas, S., Rossi, E., Frank, D. (2010), Video analysis of dogs with
8 separation related behaviours. Appl. Anim. Behav. Sci. 124 (1), 61-67

9 Patronek, G.J., Glickman, L.T., Beck, A.M., McCabe, G.P., Ecker, C., 1996. Risk factors for
10 relinquishment of dogs to an animal shelter. J. Am. Vet. Med. Assoc. 209 (3), 572-581.

11 Pierantoni, L., Albertini, M., Pirrone, F., 2011. Prevalence of owner-reported behaviours in dogs
12 separated from the litter at two different ages. Vet Rec. 169 (18), 468.

13 Reisner, I.R., Houpt, K.A., Shofer, F.S., 2005. National survey of owner-directed aggression in
14 English Springer Spaniels. J. Am. Vet. Med. Assoc. 227, 1594-1603.

15 Rugbjerg, H., Proschowsky, H. F., Ersboll, A. K., Lund, J. D., 2003. Risk factors associated with
16 interdog aggression and shooting phobias among purebred dogs in Denmark. Prev. Vet. Med. 58,
17 85-100

18 Sargisson, R.J., 2014. Canine separation anxiety: strategies for treatment and management.
19 Veterinary Medicine: Research and Reports. 5, 143–151

20 Serpell, J., Jagoe, J.A., 1995. Early experience and the development of behaviour. In: Serpell J, ed.
21 The domestic dog: its evolution, behaviour, and interactions with people. Cambridge, UK:
22 Cambridge University Press, pp 79–102

23 Sherman, B.L., Mills, D.S., 2008. Canine anxieties and phobias: an update on separation anxiety
24 and noise aversions. Vet. Clin. North Am. Small Anim. Pract. 38(5),1081–1106.

25 Svartberg, K., 2006. Breed-typical behavior in dogs - historical remnants or recent constructs?
26 Appl. Anim. Behav. Sci. 96, 293-313.

27 Tiira, K., Lohi, H. 2015. Early Life Experiences and Exercise Associate with Canine Anxieties.
28 PLoS One 10 (11), 1-16

29 Van der Borg, J. A. M., Netto, W.J., Planta, D. J. U., 1991. Behavioural testing of dogs in animal
30 shelters to predict problem behaviour. Appl Anim Behav Sci, 32, 237–251.

- 1 Voith, V.L., 1985. Attachment of people to companion animals. *Vet. Clin. Small Anim.* 2, 289-295.
- 2 Weiss, H.B., Friedman, D.I., Coben, J.H., 1998. Incidence of dog bite injuries treated in emergency
3 departments. *J. Am. Med. Assoc.* 279, 51–53.
- 4 Wright, J.C., 1991. Canine aggression toward people. Bite scenarios and prevention. *Vet. Clin.*
5 *Small Anim. Pract.* 21, 299-314
- 6 Wright, J.C., Nesselrote, M.S., 1987. Classification of behaviour problems in dogs: distributions of
7 age, breed, sex and reproductive status. *Appl. Anim. Behav. Sci.* 19, 169-178
- 8 Yalcin, E., Batmaz, H., 2007. Signalment factors, comorbidity in behaviour diagnoses in dogs in
9 Bursa Region, Turkey (2000-2004). *Acta. Vet. Brno.* 76, 445-450.
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1 **Figures**

2

3 Figure 1. Distribution of dogs' sex in the two groups of diagnosis (*p≤0.05)

4

5 Figure 2. Time of onset of the problem behavior in the two groups of diagnosis (*p≤0.05)

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7 Figure 3. Dogs' resting place in the two groups of diagnosis (*p≤0.05)

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9 Figure 4. Number of visits requested in the two groups of diagnosis (*p≤0.05)

10

11 Figure 5. Use of a pharmacological therapy in the two groups of diagnosis (*p≤0.05)

12

13

1 Table 1. Distribution of the breeds in the two groups of diagnosis.

2

BREED	AGGRESSION	ANXIETY
1	14,0%	6,4%
2	11,3%	10,8%
3	8,0%	7,6%
4	5,3%	6,5%
5	2,0%	2,7%
6	0,7%	4,3%
7	1,3%	4,9%
8	3,3%	6,5%
9	6,7%	8,1%
10	0,0%	2,2%
11	4,7%	0,0%
12	42,7%	40,0%

3