



RESEARCH

# Relationship between attachment to owners and separation anxiety in pet dogs (*Canis lupus familiaris*)

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**Abstract** Dogs' dysfunctional attachment relationships with their owners are assumed to be the underlying cause of separation anxiety. Thirty-two dogs with and 43 dogs without owner-reported separation anxiety (SA) participated in a formal attachment test (AT). After the AT, the dogs were videotaped for 30 minutes while alone at home. Dogs left free in the house were scored on how long they were in proximity to the owners' exit doors. Dogs who were crated or closely confined were scored on several anxiety-related behaviors, which were then compared to those dogs' behaviors during the attachment test. Dogs with SA spent no more time in contact with or proximity to their owners during the attachment test than dogs without SA ( $P>0.05$ ). Instead, they tended to jump up on the door after the strangers left the room and remain stationary when alone with their owners ( $P<0.05$ ). There was no significant difference ( $P>0.05$ ) between SA and non-SA dogs in the amount of time spent in proximity to the owners' exit doors when left alone at home. Dogs crated at home showed no relationship between the amount of anxiety-related behaviors during the AT or at home ( $P>0.05$ ). There was no significant difference in the type of proximity-seeking behaviors exhibited by dogs with and without SA in the home ( $P>0.02$ ). These findings suggest that separation anxiety is not based on "hyperattachment" of the dog to the owner, but that a different attachment style may be present between dogs with and without SA.

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## Introduction

### Attachment

The bond between dog and owner is one of the primary reasons people keep dogs as companion animals. Bowlby (1958) stated that attachment can be seen in the reactions of one individual when separated from another. He further described it as an emotion that one individual feels toward

another. Attachment relationships are a necessary component of living in a social group, helping to keep group members together (Voith and Borchelt, 1996). One of the strongest and most studied attachment relationships formed in mammals is the mother-infant bond.

Bowlby (1958) argued that the infant-caretaker attachment relationship was evolutionarily important for the infant, but that many of the ethological principles seen in nonhuman animals applied just as well to human beings. In addition, this bond is known to be one of the most enduring relationships between individuals (Bretherton, 1994). Bowlby's theoretical work on attachment, as well as Ainsworth's research methodology, has become the heart of current attachment theory (Ainsworth et al., 1978).

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Inspired by Konrad Lorenz's work in animal ethology, Bowlby applied ethological theory to human attachment behavior and developed the current theory of attachment. The key concepts that Bowlby drew from ethology were that human beings have: (1) *Innate behaviors* (behaviors that are essentially the same in all members of a species, e.g., focusing on faces), (2) *Fixed action patterns* (complex innate behaviors that promote species survival, e.g., attachment behaviors of infant and mother), and (3) *Sensitive periods* (specific periods during which an animal is biologically ready to acquire a particular new behavior). These aspects of infant behavior would predispose them to interact with other human beings, especially their caregiver. Through this predisposition and subsequent interactions, a pattern of attachment would form between the two (Bowlby, 1958).

Bowlby also proposed that attachment was a spatial phenomenon, whereby children exhibited specific behaviors in order to get near their caregivers. In addition, he proposed that children would learn to identify familiar people versus unfamiliar people and that they had a built-in tendency to approach familiar people and avoid unfamiliar people. Finally, the feedback the children received from the people they interacted with would affect the patterns of behavior that the child exhibited toward those individuals (Bowlby, 1958).

Bowlby's attachment theory has a strong evolutionary basis. For example, although exploratory behavior in young primates is necessary for them to learn about their physical and social world, wandering too far away from the mother would leave that infant vulnerable to predatory and conspecific attack. Therefore, it is of evolutionary benefit for the infant to seek the proximity of its mother when it is afraid, and behaviors such as crying, following, and clinging facilitate gaining and maintaining proximity (Bowlby, 1958). Bowlby also believed that this behavior (coined "separation anxiety") was a normal reaction of an infant that facilitated its coming back into and maintaining close proximity with the attachment figure (Bowlby, 1960). All of these elements interacting together would result in attachment between the child and another individual.

Whereas Bowlby provided a theory with which to study attachment, Mary S. Ainsworth developed a way to test it. Ainsworth et al. (1978) developed the Strange Situation Test, which was first used with human children. This observational test was designed to simulate situations in which attachment behaviors would manifest themselves. Children were subjected to situations of low and high stress, which triggered various intensities of attachment behaviors. Situations in which a stranger entered a room when the mother was present were considered low to medium stress, and milder attachment behaviors were expected. When the mother left the room, the child experienced a condition of high stress (Ainsworth et al., 1978).

By recording the durations of exploratory behaviors, proximity behaviors, contact initiation behaviors, play, and

vocalizations done in the presence and absence of the parent and the stranger, Ainsworth et al. then identified multiple forms of attachment styles: secure, insecure-avoidant and insecure-resistant. In general, securely attached children were upset when their mothers left the room but calmed down quickly when they reappeared; insecure-avoidant children were upset when their mothers left but tended to avoid them when they returned; and insecure-resistant children were upset when their mothers left and either clung to them or resisted being held by them when they returned (Ainsworth et al., 1978).

Thus far, studies of ethological aspects of attachment have been limited primarily to human beings (Ainsworth et al., 1978) and nonhuman primates, including macaques (Harlow and Zimmerman, 1959; Harlow and Harlow, 1966) and chimpanzees (Bard, 1983; Bard, 1991). Miller et al. (1990) also reported that chimpanzees could use human beings as their primary attachment figures, or those individuals used as a secure base from which to explore, and to whom attachment behaviors are preferentially shown. Topál et al. (1998) were the first to apply Bowlby's theory to attachment relationships between a nonprimate species and human beings.

Although many recent studies have examined attachment of pet owners to their pets (Serpell, 1996; O'Farrell, 1997; Triebenbacher et al., 1998; Prato Previde et al., 2006), fewer have specifically studied the attachment of companion animals to their owners. Scott and Fuller (1965) found that 10-week-old puppies were more likely to maintain a social relationship with a human being than to search out food when in a novel environment; in fact, under test conditions they appeared to be more interested in maintaining this relationship with human beings than with their mothers. Tuber et al. (1996) found that kennel dogs exposed to novel conditions had lower activity and glucocorticoid levels when in the company of their human caregiver than when with their kennel mates. These findings suggest that there may be differences between the dog-human bond and the bonds dogs form with other dogs.

Topál et al. (1998) investigated the topic of attachment specifically by using a modified version of the Strange Situation Test to classify attachment patterns in pet dogs. They found 5 classifications of attachment, but did not relate them to the human attachment types. No breed differences in attachment were found. However, this conclusion was based on a comparison of a group of one breed of purebred dogs with a group of mixed breed and several other breeds of dogs. Since the dog-owner relationship has been classified as analogous to the mother-infant relationship (Topál et al., 1998), it is reasonable to assume that the underlying attachment is similarly strong.

More recent studies have attempted to further address the attachment relationship of dogs toward their people. Prato Previde et al. (2003) reported that although dogs exhibited behavior similar to that of human children while in a strange situation, their data did not conclusively support the exist-

tence of a dog-human attachment. Topál et al. (2005), however, found that puppies of domestic dogs tended to show attachment behaviors selectively directed toward their human caregiver, whereas wolf puppies were not selective. This difference suggested that dogs do have attachments to the owner, and that the tendency to show attachment behavior toward particular human beings may have come about through the domestication process. Palestrini et al. (2005) found that physiological changes, namely increased heart rate, accompanied behavioral signs of stress in dogs during strange situation testing.

## Separation anxiety and attachment

As with human beings, separation of a dog from its primary attachment figure (the owner) can trigger an anxiety response. This response is called separation anxiety (SA). Separation anxiety is a very common anxiety condition that is diagnosed in dogs by behavioral consultants. Separation anxiety has been a diagnosis for 14-39% of the behavior cases seen at behavior practices (Borchelt, 1983; Voith and Borchelt, 1996; Simpson, 2000). Extreme separation anxiety is characterized by excessive vocalization, elimination in the house, and/or destructive behavior, all in the owner's absence (McCrave, 1991; Overall, 1997). Less damaging forms of separation anxiety include pacing, salivating, and trembling (McCrave, 1991; Voith and Borchelt, 1996; Overall, 1997). Although the dogs most commonly presented for separation anxiety are mixed-breed dogs from shelters, purebred dogs that have lived in the same home all of their lives can be subject to this problem (Simpson, 1998). Since behavior problems constitute one of the primary reasons for relinquishment of dogs to animal shelters (Overall, 1997), understanding the underlying bases of behavior problems can better allow for their identification and treatment.

Serpell and Jagoe (1995) indicated that an owner's attachment to a dog did not correlate with the incidence of separation anxiety. However, no studies have reported on how the degree of the dog's attachment to the owner affects the incidence of separation anxiety. It is assumed that the dog's "hyperattachment" to the owner is central to this problem, because many dogs with SA tend to stay very close to the owners while the owners are home (Takeuchi et al., 2000; Flannigan and Dodman, 2001). On the other hand, anecdotal evidence suggests that dogs without SA may also stay close to their owners. Ainsworth et al. (1978), Topál et al. (1998), and Prato Previde et al. (2003) have, with children and dogs, respectively, recorded attachment behaviors such as contact behavior, locomotion, body posture, and vocalizations. If separation anxiety is indeed based on the attachment of dogs to their owners, then dogs with SA should show different patterns of attachment behaviors than dogs without SA.

Our 3 primary hypotheses for this study stated that: (1) Dogs with SA would have different patterns of attachment-related behaviors than dogs without SA. Additionally, when

alone with their owners in a strange situation attachment test (AT), dogs with SA would spend less time investigating the test facility and more time in proximity to and in direct contact with the owner than dogs without SA. When reunited with the owner in the AT, dogs with SA would spend more time in contact with and in proximity to their owners than dogs without SA. (2) For dogs loose in the house when left alone, dogs with SA would spend more time in proximity to the owner's exit door than dogs without SA. The reasoning behind this prediction was that if SA was associated with "hyperattachment," then the dogs with SA should continue to attempt to maintain proximity to the owner even after the owner's departure by staying near the door—the place the owner was last seen. (3) For dogs who are crated in the home, there would be a positive correlation between the durations and frequencies of SA-symptomatic behaviors of these dogs while they were alone during the AT and at home. The reasoning for this prediction was that if behaviors during the AT reflected how the dogs coped with increasing levels of stress, then it should be reflected in their behavior when left alone at home. Only dogs who were crated would be able to be used for this assessment, because they would be observed for the entire study time.

## Methods

### Subjects: attachment test

The data from seventy-five pet dogs (41 spayed females, 3 intact females, 29 neutered males, 2 intact males; mean weight=24.0 kg, SD=11.3 kg) were used in this study. The dogs were recruited via fliers that were posted in local pet-related businesses, and via word of mouth by owners whose dogs had gone through the study. The flier stated that the study was looking at dogs' attachment to their owners. The owners were not told until the completion of the entire study what the variables of interest were, so that their reports of their dogs' behavior would not be influenced by their knowledge of the study, and to prevent owners influencing other potential subjects' owners with information about the reasons for the study.

### Inclusion Criteria

All dogs were obtained by the current owner at no more than 4 months of age and were between 2 and 8 years of age (mean=4.2 y, SD = 1.8 y) at the time of data collection. These restrictions were enforced to ensure that the dog had had a reasonable amount of time to form an attachment relationship with the owner if it were going to happen. Additionally, all dogs were required to be physically healthy and were not to have had any medications or other treatment of behavioral or physical disorders. Nonmedical dietary supplements, such as vitamins and flea, tick, and heartworm prevention, were allowed. The distribution of the

dog breeds included 25 mixed-breed dogs; 6 German shepherd Dogs; 5 Labrador retrievers; 4 each of Australian shepherds, golden retrievers, and Jack Russell terriers; 3 Shetland sheepdogs; 2 each of border collies, Doberman pinschers, and Rottweilers; and 1 each of American pit bull terrier, beagle, bichon frisé, boxer, Cardigan Welsh corgi, chihuahua, rough collie, standard dachshund, miniature dachshund, dalmatian, English springer spaniel, great Dane, Italian greyhound, toy poodle, pug, Weimaraner, and Welsh terrier.

All owners were required to answer a phone screen to verify that their dogs met the above inclusion criteria and to determine their dogs' primary attachment figure in the household. The primary attachment figure was identified by owner report. If multiple owners were present, then the primary attachment figure was defined as the person with whom the dog spent the most time in the closest proximity, and with whom the dog interacted the most. Finally, the owners were asked to release their dogs' past year's medical records to the researchers.

### Exclusion Criteria

Dogs who were overtly aggressive to strangers in novel environments or with a history of biting people on their property were excluded from the study. This screening process was implemented to ensure the safety of the owner and investigators during the testing procedure. Additionally, dogs who were outside 100% of the time and dogs brought inside only to be fed were excluded, because they may not have had an opportunity to form a social bond with their owners. Finally, dogs were excluded if the owner could not keep them inside for the post-AT videotaping procedure.

### General procedure: attachment test

The dogs' owners were asked to fill out 2 questionnaires prior to the attachment test. First, a behavior history form provided the investigator with general information about the dogs, as well as more specific behavioral information. For the purposes of this study, this form was used to determine demographic information on the dogs. The second questionnaire was an anxiety survey, which was used to assess whether or not the dogs had separation anxiety (SA). Questions were designed to differentiate SA from other behavior problems, such as housetraining issues, puppy destructiveness, or reactivity to outside noises. Owner knowledge of a dog's excessive barking while they were gone from home usually was due to neighbor report or was reported by the owner, who could hear the vocalizations as he or she left the house. The owners were not told what this screen was used for, in order to eliminate biased responding. In addition, the investigator examined each dog's medical records from the past year. This precaution was necessary to ensure that the study population was healthy and that the behaviors observed during testing were not caused by medical problems.

The dogs and owners then participated in the attachment test (described below), and the dogs' at-home behavior was recorded on videotape within 2 weeks of the attachment test.

### Study site—testing facility

The attachment test was conducted in a 3.14 m x 4.25 m exam room at the University of Georgia College of Veterinary Medicine, Athens, GA. Two chairs (for the owner and the stranger) were situated 1.3 m from each other and 2 m from the entry/exit door. The floor of the room was of a nonslip texture. A sink was located at one corner of the room, and a folding exam table was located against the wall. Testing took place after business hours (between 1830 and 2030 h), thereby minimizing extraneous noises that could distract or disturb the dogs. The subjects' behavior during the entire test was recorded using a Sony VITC video camera mounted on a tripod. Once the test started, the researchers did not come back into the room until the test was finished. No more than 3 tests were run on any given test day.

### Assessing attachment

An attachment test (AT), modified from Ainsworth's Strange Situation Test, was administered to each dog in the laboratory to assess the attachment of the dog to its primary attachment figure. **Table 1** shows the exact sequence of activity during the test, with the first 5 minutes being an acclimatization period to help the dog habituate to the room. The order of the strangers' gender and the chair used by the owner and strangers were randomized to minimize order and side effects. During the test, the owner and strangers did not interact with the dog (e.g. petting, talking to, looking at, touching, pushing away) or with each other, so as to prevent the maintenance of reinforced attention-seeking behaviors, and to control for the possibility that the strangers would act differently around different dogs. If a dog licked their faces, the owners and strangers were instructed to turn away or cover their faces and wait until the dog stopped on his/her own. This response was used because many people dislike being licked in the face, yet at the same time any direct interaction with the dog (e.g., pushing the dog off) could have reinforced attention-seeking behaviors that might not be solely attachment-related. The timing during the test was determined using synchronized stopwatches. The strangers (undergraduate research assistants) wore jeans, closed-toed shoes, and light-colored t-shirts during the tests.

Owners and the strangers were instructed to remain seated for the duration of the test in the specified chair, unless they were getting up to leave or had just entered the room. Entry to and exit from the room was brisk, but careful, to prevent the dogs from leaving the room. The owners were told that if at any point they were concerned about their dogs' welfare or safety they could stop the attachment test.



**Table 1** Attachment test schedule

Time (min.)	Duration (min.)	Event	Condition
0-5	5	Leave owner alone with dog	Acclimatization
5-7	2	Stranger #1 enters*	Owner + Stranger #1
7-9	2	Stranger #1 leaves	Owner only
9-11	2	Owner leaves dog in room	Alone
11-13	2	Stranger #1 enters	Stranger #1 only
13-15	2	Stranger #1 leaves	Alone
15-17	2	Owner enters	Owner only (reunion)
17-19	2	Stranger #2 enters	Owner + Stranger #2
19-21	2	Stranger #2 leaves	Owner only
21-23	2	Owner leaves	Alone
23-25	2	Stranger #2 enters	Stranger #2
25-27	2	Stranger #2 leaves	Alone
27-29	2	Owner enters	Owner only (reunion)

\*The gender of the first stranger was randomly determined in advance of the test.

## Assessing separation anxiety

The dogs' primary attachment figures were asked to fill out the Anxiety Survey prior to their dogs' AT (Appendix A). The surveys were scored, and the results were compared to a separation anxiety scale (Appendix B) developed by the investigator. Owner reports of the dogs' proximity behaviors at home (e.g., following the owners around the house) were not included as diagnostic criteria. For the purposes of this study, a score of 0-8 indicated a dog without clinical separation anxiety, whereas a score of 9 or above indicated clinical separation anxiety. The results of this questionnaire were used to determine if the dog had owner-reported separation anxiety. This assessment method underwent validation at the University of Georgia College of Veterinary Medicine's Animal Behavior Service. Thirty-six cases were compared, with 97% agreement between the scale (filled out by Behavior Service clients) and independent clinical assessments of separation anxiety during their dogs' individual behavioral consultations.

## Subjects: home videotaping

Owing to mishaps during home data collection, the data of 3 dogs could not be used. Sixty-five dogs were left free in the house, and 7 were crated or otherwise closely confined.

## Study site—dogs' homes

The dogs were videotaped in their homes for 30 minutes after their owners' departure from the house. Thirty minutes was selected because the first 30 minutes after the owners' departure is typically when dogs with separation issues begin to show inappropriate behaviors (Lund and Jørgensen, 1999). If the dogs were crated or closely confined when their owners were away, a video camera recorded all

of their behaviors during that period. If the dogs were loose in the house or in a large, but restricted, area (i.e., observation of the entire area was not possible) when their owners were away, a video camera was set up to videotape the dogs' behavior at the owners' exit door, or at the place where the owner exited the restricted area. The investigator set up the camera the night before the scheduled recording days and instructed the owners to turn the camera on 10 minutes prior to departure. The owners were also instructed not to change their morning routine and to leave lights on or windows uncovered for adequate illumination while videotaping. The owners with dogs displaying mild territorial behavior (growling, but no history of biting) were asked to keep them on leash when the investigator was in the house. Arrangements were made at this time for re-entry into the house on the recording day. On the recording day, the investigator returned to the house at least 30 minutes after the owners left, collected the equipment, and locked up the house.

## Observed behaviors—attachment test

The behaviors that were observed during the test and home portions of this study were based on the measures collected by Topál et al. (1998), in addition to behaviors specific to separation anxiety (McCrave, 1991) (Table 2). During the attachment test, all subjects were focal sampled, and all behaviors (Table 3) were recorded as states, except for bark/yelp, which was recorded as an event (Altmann, 1974). Specific locomotion (movement) behaviors to be compared with the at-home data, such as circling and pacing, were also noted at this time. Proximity measures, locomotion behaviors, and vocalizations were recorded concurrently. Behavioral data collected during the AT were converted into percentage of the duration of each segment, as the segments were not exactly identical in length, as a result of strangers and owners coming into and out of the room at similar but not identical intervals. A segment was started and/or finished when the door was observed to begin

**Table 2** List of separation anxiety-symptomatic behaviors during the attachment test and at home for dogs who were crated

During AT:	At home:
<input type="checkbox"/> Circling	<input type="checkbox"/> Biting crate door/sides
<input type="checkbox"/> Elimination	<input type="checkbox"/> Circling
<input type="checkbox"/> Jumping up on door	<input type="checkbox"/> Elimination
<input type="checkbox"/> Pacing	<input type="checkbox"/> Salivation
<input type="checkbox"/> Salivation	<input type="checkbox"/> Scratching crate door/sides/floor
<input type="checkbox"/> Scratching door	<input type="checkbox"/> Trembling
<input type="checkbox"/> Trembling	<input type="checkbox"/> Vocalizations
<input type="checkbox"/> Vocalizations	

opening (if someone was entering room) and/or finished closing (if someone left the room), depending on the content of the particular segment. Behaviors analyzed in each segment were determined by their relevance to attachment theory and separation anxiety. Furthermore, data from related segments (e.g., all stranger-only segments) were combined (Table 4).

**Observed behaviors—dogs’ homes**

Two different ethograms were used to assess the dogs’ behavior in the home. One ethogram was used for dogs who were free in the house when their owners were gone. This ethogram consisted of “Proximity” (dog in physical contact with owner’s exit door, or some part of dog’s body [excluding tail] is within 1 m of owner’s exit door) and Out of Proximity (dog is out of proximity of door). A more complex ethogram was used for dogs who were crated/closely confined (Table 5), as it was guaranteed that they would be able to be observed for the entire length of the observation session. All dogs were focal sampled.

**Data analysis**

Videotapes were analyzed using the Noldus Video-Pro video analysis system and the Noldus Observer System for Collection and Analysis of Observational Data (Leesburg, VA). All statistical analyses were run on SAS (Cary, NC) and SPSS (Chicago, IL) for Windows. A logistic regression was run to determine which behaviors were associated with a dog having a SA score of 9 or greater. General linear models were then run on the proximity and contact behaviors during the attachment test to assess differences between SA and non-SA dogs while they were alone with their owners and during owner reunions. An independent samples t-test was run to determine whether dogs with SA tended to spend more time in proximity to the owners’ exit location when their owners left them at home. Finally, a Pearson’s correlation coefficient was run to determine whether the number of SA-symptomatic behaviors was related between the AT and the home observations, for

those dogs who were closely confined. Proximity to the door during the AT was not directly compared to proximity to the door while at home, because the data collected during the attachment test were analyzed for attachment patterns si-

**Table 3** Ethogram used during the attachment test performed in the laboratory setting

Proximity	Dog in physical contact with target, <sup>a</sup> or some part of dog’s body (excluding tail) is within 0.3 m of human target or chair, or 1 m of door. If in proximity to more than 1 target, score target as person/object to which dog’s head is closest. <sup>a</sup>
Out of Proximity	Dog is out of proximity of all targets.
Moving	Dog moves from one point in the room to another; includes pacing and circling.
Stationary	Dog is standing (on all 4 feet, not moving), sitting (haunches are on ground whereas elbows are not), or lying in place (elbows and sternum, or side of dog, is touching the ground).
Jump Up	Both of the dog’s forelegs, and perhaps its other legs, are not in contact with the ground, and the dog is in proximity to a target. <sup>b</sup> If the target is a person, the dog may be entirely in his or her lap.
Bite	Dog scrapes teeth across target, or grasps target with teeth. <sup>a</sup>
Scratch	Dog scrapes front claws against surface of target. <sup>a</sup>
Tremble	Dog visibly shakes.
Salivate	Dog has saliva hanging from mouth.
Elimination	Dog urinates or defecates.
Other	Dog is performing behavior not specified on this ethogram.
Out of view	Dog is out of view of camera.
Investigate	Dog has nose within 3 cm of person or inanimate surface. <sup>b</sup>
No Investigation	Dog does not have its nose within 3 cm of person or inanimate surface.
Bark/Yelp	Sharp vocalization, often loud and repetitive.
Whine	High-pitched vocalization.
Howl	Low-pitched, long-duration vocalization.
Growl	Low-pitched grumble with or without exposed teeth.
Other Vocal	Other vocalizations not specified on this ethogram.

<sup>a</sup>Targets: Owner, male stranger, female stranger, owner’s chair (empty), stranger’s chair (empty), door  
<sup>b</sup>Targets: Owner, male stranger, female stranger, owner’s chair (empty), stranger’s chair (empty), door, other

**Table 4** List of behaviors analyzed for each attachment test segment

Owner Only	Owner Stranger	Stranger Only	Reunion	Dog Alone (Owner Leaves)	Dog Alone (Stranger Leaves)
Proximity Owner	Proximity owner	Proximity stranger	Proximity owner	Proximity owner's chair	Proximity owner's chair
Investigate owner	Proximity stranger	Proximity owner's chair	Investigate owner	Proximity door	Proximity door
Jump up owner	Investigate owner	Proximity door	Jump up owner	Investigate owner's chair	Investigate owner's chair
Jump up stranger's chair	Investigate stranger	Investigate stranger	Stationary	Investigate door	Investigate door
Stationary	Jump up owner	Investigate owner's chair	Movement	Jump up owner's chair,	Jump up owner's chair
Movement	Jump up stranger	Investigate door	Bark-Yelp	Jump up door	Jump up door
Bark-Yelp	Stationary	Jump up stranger	Whine	Stationary	Stationary
Whine	Movement	Jump up owner's chair	Howl	Movement	Movement
Howl	Bark-Yelp	Jump up door		Bark-Yelp	Bark-Yelp
	Whine	Stationary		Whine	Whine
	Howl	Movement		Howl	Howl
		Bark-Yelp			
		Whine			
		Howl			

multaneously and would not have been comparable to the data taken from the home.

Descriptive statistics on the dogs' proximity behaviors were compiled to assess the type of proximity interactions they engaged in with their owners at home. Specifically, the number and percentages of dogs with and without SA who followed their owners from room to room/stayed in the same room with them, remained in direct contact with them, and/or stayed in the same as well as other rooms, were calculated. Post-hoc chi-square analyses were run to compare these interactions between dogs with and without SA and a Bonferroni correction was used ( $\alpha=0.2$ ).

## Results

### Attachment test

Thirty-one dogs had owner-reported clinical SA (SA score greater than or equal to 9), whereas 44 dogs did not. A logistic regression was run to determine what behaviors during the AT were predictive of a separation anxiety score greater than or equal to 9. The model generated by forward stepwise analysis of the data was:

□  $DA\_SLV\_JmpUpDoor$  = dog jumped on the door while alone after the strangers left ( $P<0.05$ )

**Table 5** Ethogram used during the home videotaping session for dogs who were crated or closely confined in the house

Locomotion, etc.	<p><i>Investigate</i>: Dog has nose within 3 cm of inanimate surface.</p> <p><i>Stand</i>: Dog is standing in place without actively interacting with environment.</p> <p><i>Sit</i>: Dog's haunches are in contact with the ground, however elbows are not; not actively interacting with environment.</p> <p><i>Lying</i>: Dog is lying on sternum (with elbows contacting ground), side or back without actively interacting with the environment.<sup>a</sup></p> <p><i>Circling</i>: Dog moves in a roughly circular pattern, returning to the same spot at least twice.</p> <p><i>Bite</i>: Dog scrapes teeth across target, or grasps target with teeth.<sup>b</sup></p> <p><i>Scratch</i>: Dog scrapes front claws against surface of target.<sup>a</sup></p> <p><i>Tremble</i>: Dog visibly shakes.</p> <p><i>Salivate</i>: Dog has saliva hanging from mouth.</p> <p><i>Elimination</i>: Dog urinates or defecates.</p> <p><i>Other Behavior</i>: Dog is performing behavior not specified on this ethogram.</p>
Vocalization	<p><i>Bark/Yelp</i>: Sharp vocalization, often loud and repetitive.</p> <p><i>Whine</i>: High-pitched vocalization.</p> <p><i>Howl</i>: Low-pitched, long duration vocalization.</p> <p><i>Growl</i>: Low-pitched grumble with or without exposed teeth.</p> <p><i>Other Vocalizations</i>: Other vocalizations not specified on this ethogram.</p>

<sup>a</sup>Head position recorded as up or down (chin touching ground)

<sup>b</sup>Targets: Crate/barricade door, crate sides

**Table 6** Number and percentage of dogs with and without SA who exhibited different at-home owner proximity behaviors\*

Proximity Behavior	SA (n=31)		Non-SA (n=40)	
	Number	%	Number	%
Physical contact	8	26	3	8
Same room/follow	25	81	26	65
Other rooms as well as same room	7	23	19	48

\*Since multiple behaviors were evaluated simultaneously, a Bonferroni correction was performed to decrease the likelihood of false significant results. There were no significant differences ( $P>0.02$ ) between dogs with and without SA for any of these proximity behaviors. Four owners of non-SA dogs did not answer the question. Percentages add up to more than 100% because some owners marked multiple answers to the question.

- *OO\_Station* = stationary behavior when dog was alone with the owner ( $P<0.05$ )
- *OS\_ProxOwner* = dog maintained proximity to the owner while a stranger was present ( $P<0.05$ )

When converted into exponents, the coefficients for the 3 factors become 1.7, .95 and 1.0, respectively. Therefore, a unit increase in *DA\_SLV\_JmpUpDoor* would make a score indicating SA 1.7 times more likely. A unit increase in *OO\_Station* would result in a decrease in likelihood of a score indicating SA, and a unit increase in *OS\_ProxOwner* would result in an increase in a score indicating either SA or non-SA. However, since this last factor is not predictive of SA, it is of little practical significance.

No trembling, elimination, or salivating was noted in any dog during the AT or at home. There were no significant differences ( $P>0.05$ ) because of the order in which the different genders entered, the side of the room on which the owner sat, or which pair of strangers were participating in the study, between the 2 groups of dogs. There were also no effects of stranger gender on the dogs' behavior.

A multivariate general linear model was run comparing duration of contact and proximity behaviors toward the owner, as well as investigation behaviors of dogs with and without SA when alone with their owners. Additionally, duration of contact and proximity to owners were compared for these groups when reunited with their owners. The 2 groups did not differ significantly ( $P>0.05$ ) in any of the measures analyzed. The average coefficient of inter-observer reliability for the attachment tests was  $0.92 \pm 0.3$ .

### Home—door proximity

An independent samples t-test was used to compare the amount of time dogs with SA (n=26) and without SA (n=35) spent by the owners' exit doors. The amount of time spent by the door by dogs with SA (mean=320.87 s, SD=567.2) and without SA (mean=193.33 s, SD=447.66) was not significantly different ( $t=-0.982$ , 59,  $P>0.05$ ). The average coefficient of inter-observer reliability for the door proximity analyses was 100%.

### Crate vs. attachment test

A Pearson's correlation coefficient was run comparing the durations and frequencies of SA-symptomatic behaviors during the AT with those recorded at home for crated/confined dogs. Dogs' SA-symptomatic behaviors during the AT were not correlated with comparable behaviors when crated/confined at home ( $r=0.677$ ,  $df=5$ ,  $P>0.05$ ).

### Descriptive statistics of home proximity behavior

Chi-square analyses were run to compare proximity-related behaviors of dogs with and without SA at home (Table 6). Since multiple behaviors were evaluated simultaneously, a Bonferroni correction was performed to decrease the likelihood of false significant results. There were no significant differences between these 2 groups of dogs in maintaining contact with the owner ( $\chi^2=4.39$ ,  $df=1$ ;  $P>0.02$ ), following the owner from room to room ( $\chi^2=2.07$ ,  $df=1$ ;  $P>0.02$ ), or staying in other rooms, as well as following the owner ( $\chi^2=2.06$ ,  $df=1$ ;  $P>0.02$ ).

### Discussion

A dog's dysfunctional attachment to his or her owner is presumed to be the cause of separation anxiety. Traditionally, dogs with separation anxiety have been assumed to have an excess of attachment toward their owners (Takeuchi et al., 2000; Flannigan and Dodman, 2001). In a retrospective study at a veterinary behavior referral service, attachment behaviors of 200 dogs diagnosed with SA and 200 dogs without SA but with other behavior problems were compared (Flannigan and Dodman, 2001). Flannigan and Dodman found that dogs with SA were 3-5 times more likely to follow their owners around the house and greet them excitedly for over 2 minutes. It is important to note, however, that this difference may not reflect an excessive tendency for dogs with SA to be near the owner, but instead reflect dysfunctional attachment relationships of dogs with other behavior problems. For example, many fear-aggressive dogs may have actively avoided their owners. Additionally, the study was limited to dogs who had visited a



behavior service and who may therefore have exhibited behaviors different from the population of dogs at large. The results of this study suggest that in the general population, dogs with separation anxiety do not have an excessive attachment, but potentially an attachment pattern that is inappropriate.

During the attachment tests, dogs with separation anxiety tended to jump up on the door when alone after a stranger left the room. The lack of significance of the contact and proximity data in the AT is important, indicating that maintenance of proximity is not a primary discriminator between dogs with and without SA. Similarly, maintenance of proximity is not solely indicative of attachment in primate species or human beings (Hay, 1981). Since dogs with and without SA showed similar amounts of time staying near the owner during the attachment test, using proximity to owner during clinical assessment of SA would not be an effective indicator of the presence of SA. Anecdotally, many dogs without SA follow their owners around the house. Indeed, at least 65% of this study's dogs who did not have SA followed their owners from room to room and stayed in the same room with them, a value that is not statistically significant from those dogs with SA who followed their owners.

Maintenance of a dog's proximity to the owner's exit door when the owner leaves the home is not diagnostic of separation anxiety. It is reasonable to assume that there is a positive correlation between amount of attachment and amount of time spent in proximity to the attachment figure. Therefore, one would assume that if dogs who are hyperattached to their owners have SA, that duration of time in contact and/or proximity to the owner would have been different for the 2 groups in this study. That was not the case in either the attachment test or the proximity behaviors of the dogs with their owners at home, suggesting that SA is not correlated with hyperattachment.

In addition, the dogs with SA tended to jump on the door when alone after the strangers left during the attachment test. These segments represented periods during the test that would be relatively stressful to the dogs, since the owner had been gone for a while, and now the dog was being left alone again. Studies with monkeys and infants suggest that a secure attachment to the parent figure helps the infants mediate stress responses (Kraemer, 1997), which may be part of what is occurring with the dogs. Dogs with SA may have a different type of attachment relationship with their owners, which in turn does not allow them to mediate their responses in stressful situations.

One possible confounding factor in this study was the fact that the attachment survey did not ask questions about a dog's fear of strangers or novel situations. It is possible that some of the results, e.g., jumping on the door when the strangers left the room, may have been affected by the novelty of the room rather than the owner being gone. All of the dogs in the study, however, were prescreened to avoid potential subjects who were under treatment for behavioral

problems. The dogs were given the 5-minute segment at the beginning of the test to habituate to the room. The majority of the dogs appeared calm in the room by the time the first stranger entered. In addition, subjectively the dogs in the study did not appear afraid of new people in the test situation. Given these precautions and observations, it is unlikely that the results were caused by a fear of novel situations or strangers.

Additionally, multiple "strangers" were used during the course of this study. Although it would have been ideal to have the same male and female strangers through the entire study, doing so was not feasible because undergraduate volunteers were needed. Variability was minimized by having all strangers wear the same type of clothing, and they were instructed to act in the same way. Analysis of the data indicated that there were no significant differences in how the dogs acted around the different strangers.

Attachment is seen as a reciprocal relationship between the primary attachment figure and the individual. The individual gets information from the way the attachment figure is treating him/her, and that affects how the attachment relationship forms and changes (Bowlby, 1958). One would expect that the single owner with multiple pet dogs would treat each dog similarly, resulting in similar types of attachment for all the dogs. However, SA is commonly seen in dogs who live with other dogs. It may be that subtle differences in how the owners act toward the different dogs can profoundly affect their attachment relationship (Lund and Jørgensen, 1999). Alternatively, dogs may be so strongly affected by previous experiences (perhaps of inappropriate attachment relationships) that even years of a stable, reciprocal relationship do not alter the incidence of SA. Clinical studies of human beings have shown that changing the attachment relationship between a mother and child can help treat the child's dysfunctional behavior (Lojkasek et al., 1994). Further research needs to explore whether successfully treating a dog for SA is associated with a change in attachment behavior patterns, as well.

The findings in this study are relevant for the clinical diagnosis and treatment of SA for many reasons. Foremost, SA should not be looked at as a disorder stemming from hyperattachment of the dog to the owner. How a dog acts with its owner is an important component of clinical assessment of dogs with possible SA. However, often the dogs' proximity and contact behaviors are noted, as is the dogs' behavior when their owners leave the room. This study shows that focusing on these behaviors may not be appropriate for diagnosis of SA. Regardless of their SA status, all of the dogs in the study showed behavioral signs of increased anxiety when their owners left the room.

An alternative diagnostic method could be to set up a shorter version of this test, whereby the dog is exposed to increasing amounts of stress while the owner is gone and an assessment of its behavior could be made. For example, devising a test in which the owner leaves the room, a stranger enters, waits, and leaves, and the owner returns

could give opportunities for the dog to exhibit the behaviors predicted by this study's model. Alternatively, one could devise a test that would specifically promote behaviors associated with dogs with clinical SA, such as jumping up when alone after a stranger has left the room.

The home videotapes of the dogs who were free in the house indicated no difference in maintenance of proximity to the door after the owners left the house. This finding reflects the results of the attachment test, thereby suggesting that maintenance of proximity to the owner's last known area is not diagnostic of SA. The crated dogs showed no relationship in the amount of SA-symptomatic behaviors while alone during the AT versus alone at home. The sample size for this analysis was small, therefore a larger sample might illuminate any relationships that could be associated between the two. On the other hand, if there is indeed no relationship between the number of SA-related behaviors while alone during the attachment test versus being home alone, this finding supports the result of the analysis of attachment-related behaviors exhibited during the AT.

Although recent research (Topál et al., 1998; Prato Previde et al., 2003; Palestini et al., 2005) has helped shed light on different aspects of the canine-human bond, it has also illustrated the importance of understanding the multifactorial nature of this relationship, and it has indicated that more study is needed on this topic. More research also needs to be carried out on the effects of treatment on changes in the attachment relationship between people and their pet dogs. Additionally, by understanding how attachment plays a role in the development of separation anxiety, modifying dysfunctional attachment relationships may help prevent separation anxiety from becoming a problem in dogs who may be susceptible to this disorder.

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**Appendix A:** Anxiety survey. This key provided the numerical score needed to classify the subjects as having or not having clinical SA. The numbers in the brackets indicate how many points each answer was worth. If the answer was on a numerical scale, the number circled was the score.

\* What does your dog do while you are getting ready to leave your house?

- Ignores you [0]                       Watches you [0.5]                       Paces [2]  
 Whines/whimpers [2]                       Salivates [2]                       Looks anxious/"depressed" [2]  
 Trembles [2]                       Other: \_\_\_\_\_ [1]

\* What does your dog do after you have **stepped outside** your house:

- No reaction [0]  
 Looks out window [0.5]  
 Scratches at door(s) / window(s) / crate [2]  
 Bites/claws at door(s) / window(s) / crate [2]  
 Vocalizes (whines, barks, howls) [2]

\* What does your dog typically do when you **return home**:

- Ignores you [0]  
 Greets you (noses, licks, pushes against, etc) for less than 1 minute [0.5]  
 Jumps on you for less than 1minute [1]  
 Follows you around the house for less than 1 minute [1]  
 Vocalizes at you for less than 1 minute [1]  
 Greets you (noses, licks, pushes against, etc) for 1 or more minutes [2]  
 Jumps on you for 1 or more minutes [2]  
 Vocalizes at you for 1 or more minutes [2]

\* What does your dog do the majority of time while you are at home:

- Ignores you  
 Stays in another room  
 Stays in other rooms and in room you are in  
 Stays in the room you are in  
 Follows you from room to room  
 Stays in physical contact with you

\* Has your dog **salivated excessively** while alone in the house after one year of age? YES NO

If "YES," please circle the appropriate answers for the descriptions below:

Quantity:

Damp around mouth [1]      Wet around mouth [2]      Damp around mouth and forepaws [3]      Wet around mouth and forepaws [4]

Frequency:

Less than once/month [1]                      1-2 times/ month [1.5]                      3-4 times/month [2]                      5-7 times/month [2.5]  
 2-6 times/week [4]                      Once/ day [5]                      More than once per day [7]

Has your dog **eliminated** while alone in the house after one year of age? YES NO

If "YES," please circle the appropriate answers for the descriptions below:

Type: Urination Defecation Both

Frequency:

Less than once/month [1]                      1-2 times/ month [1.5]                      3-4 times/month [2]                      5-7 times/month [2.5]  
 2-6 times/week [4]                      Once/ day [5]                      More than once per day [7]

\* Has your dog **destroyed anything** while alone in the house after one year of age? YES NO

If "YES", please circle the appropriate answers for the descriptions below:

What Destroyed:

Small items (e.g. pens, paper, etc.)      Medium-sized items (e.g. pillows, etc.)      Furniture      Windows, doors, doorframes, other exit points from house      Structural damage (e.g. holes in wall, torn up linoleum, etc.)

