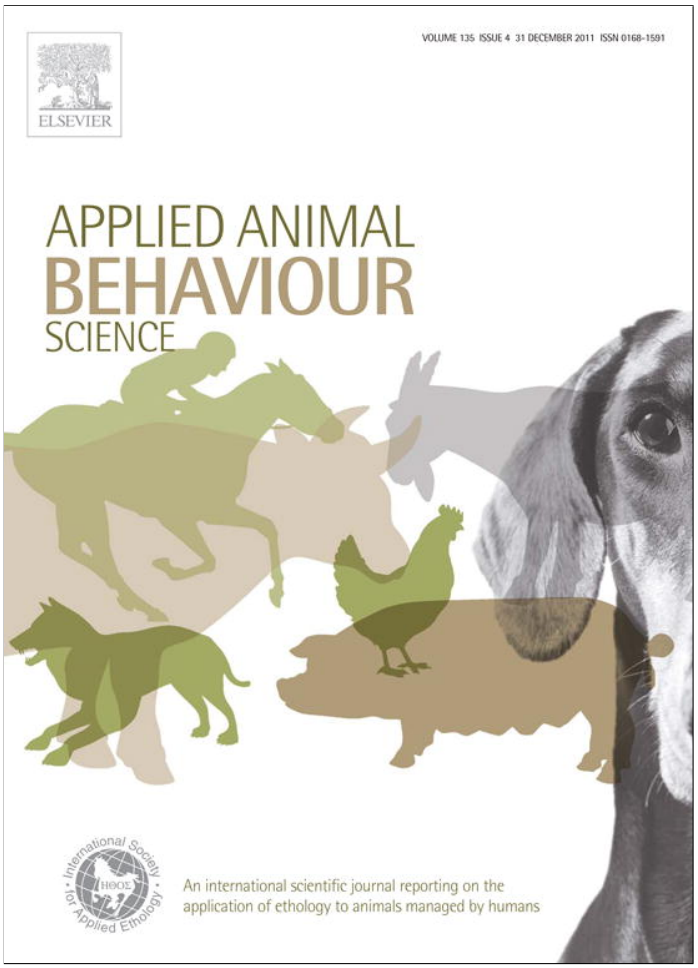

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The behavior of the domestic dog (*Canis familiaris*) during separation from and reunion with the owner: A questionnaire and an experimental study

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ABSTRACT

We have constructed a questionnaire to investigate the separation behavior in a sample of family dogs (*Canis familiaris*) ($N = 45$) and in parallel we have observed dogs' separation-related behavior in a simple behavioral test (*Separation and greeting test*, *S&G*). We recorded the dogs' behavior during the separation from and reunion (greeting) with the owner. We investigated whether owners' report about their dogs' separation behavior reflected the separation behavior under controlled testing conditions. Furthermore, we wanted to find out whether the duration of separation affected the behavior of dogs and whether there was some relationship between separation and greeting behavior.

Dogs that were rated by their owner to be more "anxious" during separation and "happier" at reunion, showed more activity and stress-related behavior during separation, and more affection toward the owner during greeting. Dogs with owner-reported *separation-related disorder* (SRD) showed more stress-related behavior, they spent less time near the owner's chair during separation, and were more active during greeting than dogs without SRD. The two groups of dogs did not differ in affectionate behavior shown toward the owner. Non-affected dogs' activity decreased with increasing separation duration, but dogs with SRD did not show this change in their separation behavior.

Our results show that owners' have a realistic view on their dogs' separation behavior. In addition, dogs with SRD may not be "hyper-attached" to their owners because they do not show more affection during greeting. Moreover, dogs with SRD do not show preference for the owners' objects left behind and they cannot be easily calmed by the returning owner.

Our questionnaire and the *Separation and greeting test* could be used for screening dogs with suspected separation-related behavior problems.

1. Introduction

For social animals the group has a survival function because being alone could be dangerous. Pairs and larger groups are held together by social bonds (Carter, 1998). Attachment can be considered as a particular kind of affectionate bond which can exist between peers (Higley et al., 1992), monogamous sexual mates (Remage-Healey et al., 2003) and most obviously between parent and its offspring (Ainsworth and Bell, 1970). According to Bowlby (1969) the ultimate function of parent–offspring attachment is to protect against predators and maintain the supply of resources for offspring if they remain in proximity to the parent(s). Attached individuals (e.g. offspring) tend to maintain proximity to and contact with the attachment

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figure (e.g. parent) and become distressed when separation occurs (Bowlby, 1969). Several studies showed that in many species a brief separation from the mother induced behavioral and/or physiological indicators of stress (e.g. human infants: Ainsworth and Bell, 1970; squirrel monkey (*Saimiri* sp): Coe et al., 1978; dog (*Canis familiaris*): Elliot and Scott, 1961).

The attachment is controlled through proximity-*seeking* and proximity-*maintaining* behaviors. These behaviors may modulate the reaction of the mother (or other social partners). In the case of human infants crying elicits approach in the mother, while smiling, babbling or eye-contact keep the mother close to the baby (Bowlby, 1969).

Dog–human relationship manifests a very special case because social ties develop among members of two different species. Nevertheless it has been argued that family dogs live in a mutual attachment relationship with their human companion(s) (e.g. Kurdek, 2009; Serpell, 1996). In addition, the application of the Strange Situation Test (Ainsworth, 1969) revealed that dogs shows functionally analogue behaviors to human infants: they tend to maintain proximity and showing stress-related behaviors after brief separations from the owner (Topál et al., 1998; Prato-Previde et al., 2003). Dogs utilize the owner as a "secure base" for exploring the environment (Prato-Previde et al., 2003) similarly to human infants. It has been supposed that the domestication predisposed dogs to form attachment relationships with humans (Topál et al., 2005). The emergence of an attachment relationship could be facilitated by some "infantile" morphological and behavioral features in dogs (Coppinger et al., 1987).

Although the stress-related behavior to separation is an adaptive response of the attached individual, normal maturation results in increased tolerance to both spatial and temporal separation from the attachment figure. However, both in humans and in dogs some in the course of development some individuals maintain a lower threshold for the activation of the attachment system which is often considered to be problematic (abnormal), due to its extreme degree, form and consequences.

Separation-related disorder (SRD) (Gaultier et al., 2005) is a common behavior problem in dogs, when the problematic behavior occurs exclusively in the owner's absence or virtual absence. Owners of dogs with SRD complain most frequently about destructive behavior displayed at home, excessive vocalization (often noticed by neighbors), or inappropriate elimination (urination/defecation) (Sherman, 2008). A recent study showed that dogs with SRD are characterized with a negative affective state which manifests in a cognitive bias in an ambiguous choice task (Mendl et al., 2010).

In the veterinary literature questionnaires are often used (e.g. Overall et al., 2001; McGreevy and Masters, 2008) to measure separation behavior and separation-related disorder in dogs, but so far the questionnaires have not been validated by the means of behavior tests. Some studies have been carried out to observe separation behavior directly and to make standardized behavioral measurement (Lund and Jørgensen, 1999; Parthasarathy and Crowell-Davis, 2006; Palestrini et al., 2010; Rehn and Keeling, 2011), but there were no collations of these behavioral observations and the reports of the owners. Owners report was used mostly for screening of dogs.

In some cases owners may infer the separation behavior of the dog indirectly only, for example by observing the intensity of the greeting behavior of the dog. One may assume that the amount of stressful experience influences directly the greeting behavior of the dog, or alternatively, it is possible that regardless of the separation some dogs greet their owners more or less enthusiastically. Previous studies on attachment (e.g. Topál et al., 1998; Prato-Previde et al., 2003; Gácsi et al., 2001, etc.) observed behavior both during separation and at greeting but they did not focus on the association between them. In line with this a recent study (Rehn and Keeling, 2011) reported that the longer the separation the more interaction the dog initiates with the owner and the more tail-wagging and owner-directed attentive behavior the dog displays in the post-separation period (10 min after owner's arrival).

It has been assumed that the behavior may change with increasing time of separation. Bowlby (1969) observed that children and young primates went through the same behavior sequence when separated from the attachment figure. The initial "protest" phase which consists of crying, screaming and burst of anger was followed by the "despair" phase which is characterized by the decrease of motor and vocal activity. If separation continues, the process eventuates in "detachment" from the attachment figure, and the young animal/child will be active and independent. Each phase can be considered as an adaptive strategy to survive. In accordance with this, and in the case of the dog, Lund and Jørgensen (1999) found that activity and the frequency of some distress-related behavior elements decreased with time during a 4-h long period. In contrast, in the study of Rehn and Keeling (2011) dogs' behavior did not change in parallel with different (0.5-, 2- and 4-h long) separation durations. However, the comparability of the two studies is limited, because in the former only dogs with SRD, while in the latter only dogs without SRD were observed. However, Palestrini et al. (2010) found no significant change even in the separation behavior of dogs with SRD, during a 40-min long separation at home.

Thus, the aim of the present study was threefold. First, we introduced a questionnaire (separation questionnaire) to estimate the prevalence of separation related disorder in a small sample of family dogs. Second, we designed a simple behavioral test (S&G) in order to validate owner's report on their dogs' separation-related behavior. We assumed that owner's indication of SRD in their dog will be associated with certain behavior pattern displayed during separation and greeting. Third, we wanted to see whether the manipulation of separation duration affects the behavior of the dogs, predicting that the duration of separation affects the dog's separation and greeting behavior.

2. Methods

2.1. Subjects

45 dogs and their owners participated in the test. One separation questionnaire was lost due to technical reasons. Dogs' median age was 4.2 years (ranging from 1.2 to 11.6

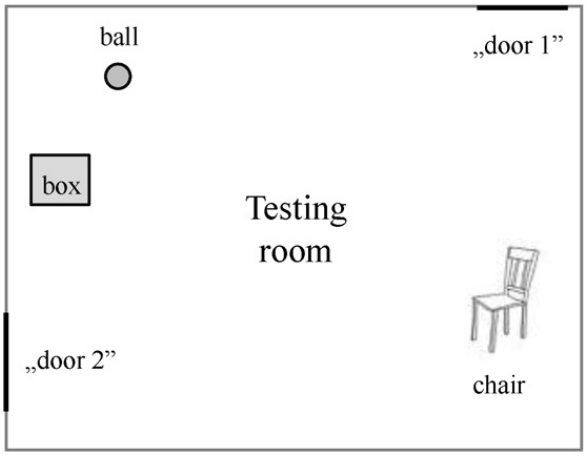

Fig. 1. The layout of the testing room.

years); there were 18 males, 27 females, 16 mixed and 29 pure breeds. From the 45 dogs 15 had separation problem according to the Separation Questionnaire (see below). From the 15 dogs 12 were males, and only three were females, which is in contrast with the gender-proportion of the whole sample. The median age of the dogs with separation problem did not differ from the dogs without a problem (Mann–Whitney test; $U = 199.5$; $p = 0.656$).

All procedures were approved by the Ethical Committee of Eötvös Loránd University, Department of Ethology and conducted in accordance with the Hungarian State Health and Medical Service (ÁNTSZ).

2.2. Materials

The experiments took place in the Laboratory of the Department of Ethology, Eötvös Loránd University, Budapest, Hungary. The layout of the testing room is depicted in Fig. 1. A ball, a paper box, a cupboard, and a chair were placed into the room before starting the experiment. The video-recording was made with four cameras. The view of the cameras was transferred to a computer in the adjacent room, where the experimenter could observe the events in the testing room. The experimenter gave instructions to the owner via a headset.

Before the experiment the owners were asked to fill out the separation questionnaire regarding their habits and feelings in connection with leaving their dogs alone. The items of the questionnaire are listed in Appendix B.

2.3. Procedure

From the 45 dogs 15 were tested with a 1-min-long separation, 15 with a 3-min-long separation, and 15 with a 5-min-long separation (between subject design). In the different conditions the proportion of dogs with and without separation problem did not differ (*G*-test, $G = 0.627$; $p = 0.731$). The test consisted of three phases.

Introduction phase: The dog and the owner entered the testing room, and dog was allowed to walk around off leash. The owner closed the door, put the leash on the back of the chair and sat down. The observation started one min after the owner had taken the seat. During this period the owner was allowed to look at the dog and talk to it, but he/she was not allowed to touch it. If the dog brought the ball to the owner, he/she was not allowed to play with the dog. After 1 min the experimenter told the owner via the headphone to say goodbye to the dog and to go out from the testing room through “door 1” (see Fig. 1). Then the owner went out to the corridor, and came into the room, where the experimenter was sitting.

Separation phase: The phase started when the owner closed “door 1”. Depending on the condition, the separation phase lasted 1, 3 or 5 min. At the end of the separation the owner was asked to go to “door 2” and call the dog loudly twice by its name separated by 5 s break. This was done in order to move the dog away from “door 1” before the owner returned to the testing room. This allowed us to observe how fast the dogs approach the owner.

Greeting phase: The owner entered through “door 1”. After stepping in he/she closed the door and greeted the dog. Owners were free to interact with the dog, however, they were told that they should greet the dog intensely, pet it and talk to it. The greeting lasted for 15 s from the owner stepping in the testing room.

After the greeting the owner was told to put the leash back and leave the room with the dog. Two sample videos showing the whole procedure are available at http://www.cmdbase.org/web/guest/play/-/videoplayer/43 and http://www.cmdbase.org/web/guest/play/-/videoplayer/44.

2.4. Behavior coding

The videotapes of the experiments were coded with Solomon Coder beta 10.11.29 (Copyright © 2010 András Péter; http://solomoncoder.com/). The behavior of the dogs was coded during the last minute of separation (which was the only minute in the case of the 1-min-long separation) and during the greeting. Coded behavior elements, their definitions and the corresponding test phases are listed in Table 1. The relative percentage of the time spent with these behaviors was established.

Twenty percent of the videos ($N = 9$, three per conditions) were coded also by a second observer. Inter-observer reliability was determined for each variable category by counting Cohen’s Kappa coefficients between the coding of the two observers. The reliability can be considered as very good, the Cohen’s Kappa ranged from 0.698 to 0.88.

2.5. Data analysis

Before analyzing the questionnaire and the S&G test, we formed scales in order to reduce data and to avoid multiple comparisons.

Internal consistencies of the questionnaire scales were high, Cronbach’s alphas are presented in brackets. We formed a scale called “*Owner-worry*” (0.87) from the items reflecting the owners’ worry about leaving the dog alone (items 7–9). In parallel, we constructed a scale named “*Dog-worry*” (0.837) from the items describing the dogs’ worry when separated from owner (items 10–12). Similarly we merged items 13 to 15 in a scale called “*Need-for-calming*”

Table 1
The behavior units coded in the separation (S) and greeting (G) phase.

Category	Behavior element	Test phases in which the behavior unit was coded	Definition
Posture/moving	Lying	S[a]&G[b]	The dog's elbows and sternum, or side touch the ground.
	Sitting	S&G	The dog's haunches are on the ground, whereas elbows are not.
	Standing	S&G	The dog is on all four feet, not moving.
	Walking	S&G	Dog moves from one point to another, three feet on the ground at any time.
	Running	S&G	Dog moves rapidly from one point to another.
	Rearing to the owner	G	The dog stands on its hind legs, and puts its forelegs on the owner's body.
	Rearing to the wall or door	S	The dog stands on its hind legs, and puts its forelegs on the wall or on the door.
Tail-wagging	Slow tail-wagging	S&G	The duration of one tail-amplitude is more than 0.2 s.
	Fast tail-wagging	S&G	The duration of one tail-amplitude is 0.2 s or less.
Vocalization	Whining	S&G	High-pitched vocalization.
Distance	Proximity to the chair	S	The dog's closest point is within 1 m from the chair.
	Proximity to the owner	G	The dog's closest point is within one meter from the owner.
	Proximity to the doors	S	The dog's closest point is within one meter from any of the doors.
Looking	Looking at owner	G	The dog looks in the direction of the owner (at any body part) (close visual inspection, distant visual inspection).
Contact	Contact with the door (scratching)	S	The dog is in physical contact with the door, including scratching it, or touching it with paw or nose.

[a] Separation.
[b] Greeting.

(0.782), and items 16 to 17 were merged to a scale named "*Dog-joy*" (0.83). Neither of the scales was normally distributed.

We formed scales also from the correlating behavioral variables of the S&G test which seemed to refer to the same underlying construct. The *Separation activity* scale was formed from standing, walking, running, and lying (inverse) (0.69). The *Separation distress* scale consisted of whining, tail-wagging (fast and slow together), physical contact with the door (scratching), and rearing on the wall or the door (0.68). [There are several reports supporting this scale; vocalization can occur as a consequence of fear or anxiety (Landsberg et al., 2003; Overall, 1997). Tail-wagging may indicate stress (Beerda et al., 2000). Destruction is one of the main symptoms of separation-related disorder of dogs (Sherman, 2008)]. The *Greeting affection* scale with moderate internal consistency (0.543) was formed based on proximity to owner, looking at owner, fast tail-wagging, rearing to the owner and walking (inverse). Additionally, we used "running" as a separate variable to indicate *Greeting activity* (Running did not correlate with any other behavior).

From these four scales, three (*Separation Activity*, *Separation Distress* and *Greeting Activity*) were not normally distributed, because a large percent of the dogs had zero values (*Separation Activity*: 22.2%, $N = 10$, *Separation Distress*: 40%, $N = 18$ and *Greeting Activity*: 57.7%, $N = 26$). The large number of tied values which would occur with standard non-parametric comparisons may lead to inappropriate results (Ruxton et al., 2010). Thus we chose to form binary variables, that is, to recode the original variables, according to whether the behavior occurred or not. We applied this method to the *Separation Activity*, *Separation Distress* and *Greeting Activity* scales. The *Greeting Affection* scale was however normally distributed, so we left it unchanged, as a continuous variable (for the summary of the questionnaire and behavior scales, see Table 2).

2.6. Statistical analyses

We used SPSS 16.0 for the statistical analysis. Associations among questionnaire scales were analyzed by Spearman correlation because most of the items were not normally distributed. With the binary behavior variables Chi-square tests (or Fisher's exact tests, when cells had expected count less than 5) were applied when analyzing the association with the presence of SRD; Chi-square tests when analyzing the effect of separation duration (condition); and Mann–Whitney or *T*-tests when analyzing the associations between the binary variables and certain behavioral (e.g. *Greeting Affection*) or questionnaire (e.g. *Owner-worry*) scales. With the *Greeting Affection* scale ANOVA was used to analyze the effect of condition and Spearman correlations to analyze associations with questionnaire scales. We used 0.05 as the value of alpha.

3. Results

3.1. Descriptive analysis of the questionnaire ($N = 44$)

Most of the owners (39 from the 44) leave their dog alone at least 3–6 times per week. Half of them (22) leave the dog alone for 4–8 h, 11 owners for more than 8 h, and 10 owners for 1–4 h. Owners usually leave the dog alone at home (in the flat or in the garden).

From the 15 owners whose dog has separation problem, 11 owners complained about continuous vocalization (whining, howling and/or barking), seven about

Table 2
Description of the questionnaire and behavior scales.

Name of the scale	Relating test	Content of the scale	Cronbach's Alfa	Transformation of the scale for the statistical analysis
Owner-worry	Separation questionnaire	Items 7–9	0.87	No transformation
Dog-anxiety[a]	Separation questionnaire	Items 10–12 (Dog-worry) and items 13–15 (Need-for-calming)	0.885	No transformation
Dog-joy	Separation questionnaire	Items 16–17	0.83	No transformation
Separation activity	S&Gtest	Standing, walking, running, lying (inverse)	0.69	Into binary (categorical) variable
Separation distress	S&Gtest	Whining, tail-wagging (fast and slow together), physical contact with the door (scratching), rearing on the wall or the door	0.68	Into binary (categorical) variable
Greeting affection	S&Gtest	Proximity to owner, looking at owner, fast tail-wagging, rearing to the owner walking (inverse)	0.543	No transformation
Greeting activity	S&Gtest	Running		Into binary (categorical) variable

[a] This scale was formed later by merging "Dog-worry" and "Need-for-calming" scales – see later, in the results.

destructive behavior (scratching of the door/wall, chewing of objects), and only one about urination. There were four other responses, which referred to anxiousness, "hissy" or waiting for the owner at the gate.

3.2. Correlations between the questionnaire scales (N = 44)

Owner-worry correlated positively with *Dog-worry* ($r_s = 0.763$, $p < 0.001$) and with *Need-for-calming* ($r_s = 0.551$, $p < 0.001$) scales. *Dog-worry* correlated with *Dogjoy* ($r_s = 0.414$, $p = 0.005$), and with *Need-for-calming* ($r_s = 0.746$, $p < 0.001$). Because of these strong correlations and the possibly similar background construct (both scales describe dogs' anxiety), we merged the *Dog-worry* and the *Need-for-calming* scales into a new scale, that we called *Dog-anxiety* (Cronbach's Alpha = 0.885, normally distributed). Thus for further analysis we used three scales (*Owner-worry, Dog-anxiety* and *Dog-joy*) (Table 2).

3.3. Analyses of the S&G test

3.3.1. Validation of behavioral observations with the separation questionnaire scales (N = 44)

Dogs displaying more activity during separation (*Separation Activity*) got higher scores on both the *Dog-anxiety* scale and the *Dog-joy* scale. The more stressful a dog was during separation (*Separation Distress*), the higher scores it obtained on the *Dog-anxiety*, *Owner-worry* and *Dog-joy* scale (for the summary of the results, the test and *p* values, and the medians of the subgroups, see Table 3).

Dogs showing more affection toward the owner (*Greeting Affection*) got higher points on the *Dog-anxiety* and *Dog-joy* questionnaire scales, and dogs who were more active in greeting (*Greeting Activity*), obtained higher scores on *Owner-worry* scale (see also Table 3).

3.3.2. Comparison of the behavior of dogs with and without SRD (N = 44)

Comparing *Separation Activity*, *Separation Distress*, *Greeting Activity* and *Greeting Affection* in dogs with and without an owner-reported separation problem (SRD) we found that in dogs with SRD the proportion of those who showed *Separation Distress* during separation and *Greeting Activity* at encountering the owner was significantly higher than in dogs without SRD (Fisher's exact test, $p = 0.003$; $p = 0.03$ respectively) (Fig. 2). There was no significant difference between the two groups in *Separation Activity* and *Greeting Affection*.

In addition in dogs with SRD the proportion of those who stayed (for any duration) in proximity to the chair was lower than in dogs without SRD (Fisher's exact test, $p = 0.009$) (Fig. 2).

For further comparison we selected dogs from the non-SRD group that had higher "*Dog-anxiety*" score ($N = 13$) than the group average. We compared these, highly anxious dogs with SRD dogs ($N = 15$). The two groups did not differ in any of the questionnaire scales, however we found that in SRD dogs the proportion of those who stayed (for any duration) in proximity to the chair was lower than in highly anxious dogs without SRD ($\chi^2 = 12.253$; $p < 0.001$). In contrast, in SRD dogs the proportion of dogs who had physical contact with the doors ($\chi^2 = 3.877$; $p = 0.049$) was higher than in highly anxious dogs without SRD.

3.3.3. Effects of separation duration (N = 45)

First we analyzed the effect of condition on the whole sample ($N = 45$). From the 4 variables, separation time affected only the *Separation Activity* (Chi^2 test, $\chi^2 = 7.2$; $p = 0.027$), dogs became less active with longer separation. We got similar results when we analyzed the effect of condition on the non-affected dogs solely ($N = 29$): i.e. dogs became less active with longer duration of separation

Table 3
Summary of the results regarding the associations between the behavioral and questionnaire variables.

Behavioral variable in the S&G test	Questionnaire scale	Median of the group with "0" value	Median of the group with "1" value
Separation activity #[a]	Dog-anxiety ($U = 85$, $p = 0.017$)	1.5	2.33
	Dog-joy ($U = 74$, $p = 0.005$)	3.75	4.5
Separation distress #	Dog-anxiety ($U = 48.5$, $p < 0.001$)	1.33	2.67
	Dog-joy ($U = 113$, $p = 0.004$)	4	4.5
	Owner-worry ($U = 82.5$, $p < 0.001$)	1.33	2.67
Greeting activity (Running) #	Owner-worry ($U = 141.5$, $p = 0.022$)	1.67	2.33
Greeting affection ##[b]	Dog-anxiety ($r_s = 0.338$; $p = 0.025$)	–	–
	Dog-joy ($r_s = 0.298$; $p = 0.05$)	–	–

[a] # indicates that the variable is categorical (binary).
[b] ## indicates that the variable is continuous (scale).

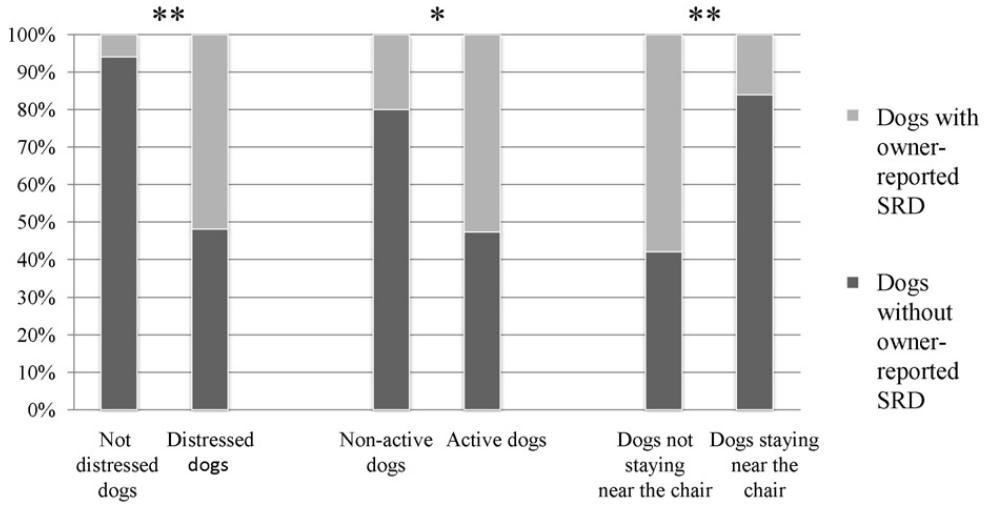

Fig. 2. *Separation Distress* and staying at the owner's chair (*proximity to chair*) during separation, and activity (running) during greeting (*greeting activity*) in the separation and greeting test were more common in dogs with owner reported SRD (separation-related disorder) (Chi-square test, $^{*}p < 0.05$, $^{**}p < 0.01$).

($\chi^2 = 6.913$; $p = 0.032$) (Fig. 3), but separation time did not affect the other three variables. However, in dogs with SRD ($N = 15$) separation duration had no influence on activity, either ($\chi^2 = 2.143$; $p = 0.34$) (Fig. 3). While in the non-affected group nine dogs were passive during separation (i.e. they had a zero value on the *Separation Activity* variable) independently from the condition, from the SRD group only one did not show *Separation Activity*, which can explain the lack of time-effect in this group.

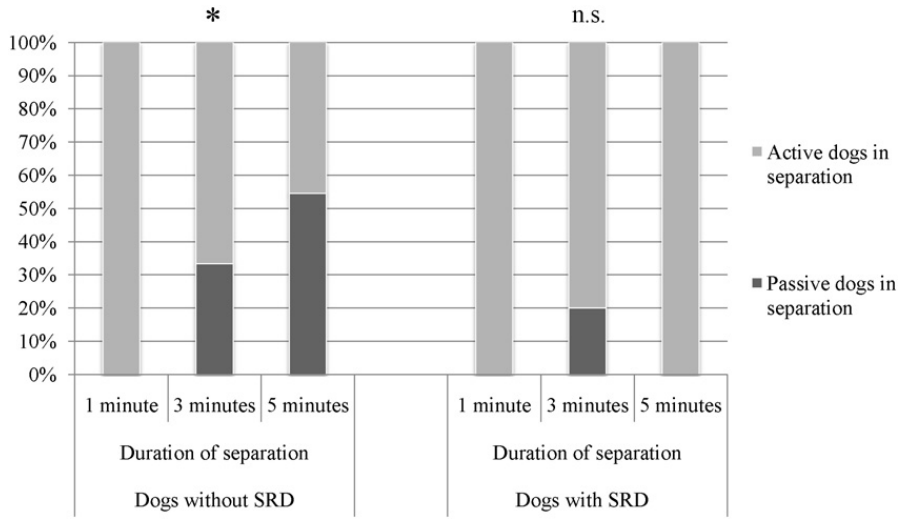

Fig. 3. The number of dog categorized as passive or active which were tested under different durations of separation (1, 3 and 5-min) (*G*-test, $^{**}p < 0.01$).

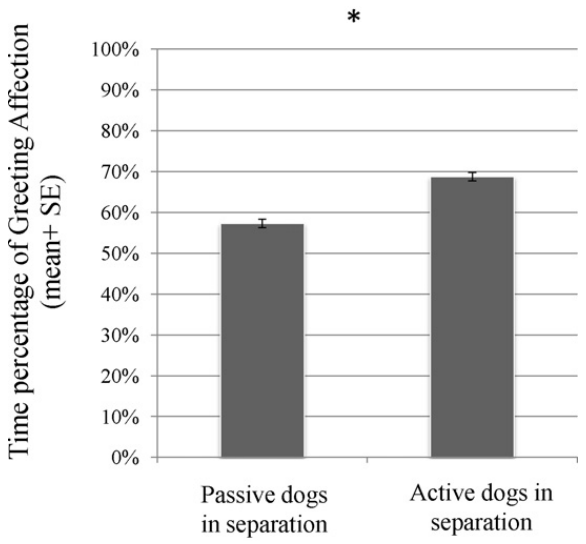

Fig. 4. Effect of dogs' separation activity (whether they were active or passive in the separation phase of the Separation and Greeting test) on the time they spent with greeting affection (affectionate behaviors toward the owner) (*T*-test, $^{*}p < 0.05$).

3.3.4. Association between separation and greeting behavior (N = 45)

We found that dogs that were active during separation (*Separation Activity*) showed significantly more affection toward the owner during greeting (*Greeting Affection*) (*T*-test, $t = 2.454$, $p = 0.018$) (Fig. 4). Additionally, there were significantly more active dogs during greeting (*Greeting Activity*) among dogs who showed *Separation Distress* than among dogs without any sign of *Separation Distress* (Chi^2 test, $\chi^2 = 4.919$, $p = 0.027$) (Fig. 5).

4. Discussion

4.1. Validation of behavioral observation with the questionnaire

We assumed that owners are aware of the separation behavior of their dogs (McGreevy and Masters, 2008). Thus we aimed at validating our behavioral observations in the test situation by the means of the separation questionnaire. We found that dogs with higher *Separation Activity* and *Separation Distress* in the test are more anxious when alone according to their owners' report, and dogs showing higher affection toward their owner during greeting are perceived by the owner as the most "happy" on reunion. These associations provide strong convergent validity for our observations. Further, owners worry mostly about dogs with higher separation distress and greeting activity, which is in accordance with the finding that dogs with separation problem have higher scores on these behavior variables. This is the first demonstration that there is an association between dogs' separation behavior and owners' reports on its situation-related feelings.

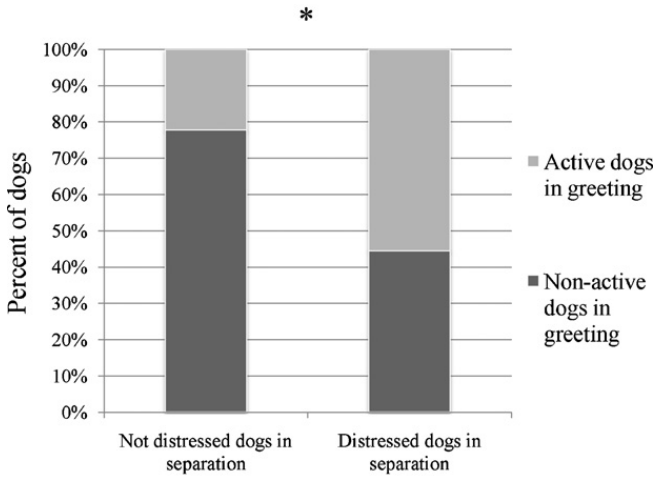

Fig. 5. The percentages of active and non-active dogs' during greeting in dogs categorized as either showing distress or not showing distress during separation (Chi-square test, $^{*}p < 0.05$).

4.2. Association between separation and greeting behavior

We assumed that separation behavior is associated with greeting behavior. This idea has received some support because we found that the more active dogs were during the separation, the more affection they displayed toward the owner during greeting. In parallel the more stressful dogs were during the separation, the more active they behaved during greeting.

4.3. Effects of separation duration

We have also hypothesized that duration of separation affects the separation and greeting behavior of dog. In the present study we have found evidence only for the former, specifically, that during separation activity decreased with time (in accordance with Bowlby's observation on children, see above). Similar finding was reported by Lund and Jørgensen (1999), although they observed the dogs during a 4-h long separation in their homes. Additionally, they observed only dogs with SRD, while our sample was a random family dog sample consisting of both healthy and SRD dogs. In a parallel study dogs without SRD did not change their behavior over long durations (0.5-, 2- and 4-h long) of separation, when they were left alone at home (Rehn and Keeling, 2011). Dogs could be more or less habituated to the absence of the owner at home because this situation may occur frequently. Thus, separation at home may not activate strongly their attachment system. This may explain the lack of behavioral change in dogs without SRD (Rehn and Keeling, 2011). However, dogs with SRD may react strongly even to such common cases of separation (Lund and Jørgensen, 1999). Our findings show that at a strange place (which may activate to a larger degree the dog's attachment system (Topál et al., 1998) even normal dogs show these changes in the separation behavior, and even during a shorter period of separation. In contrast, dogs with SRD maintain their activity also during the 5-min-long separation. This shows that these latter dogs show a mal-adaptive behavior with regard to the current situation (see also Bowlby, 1969), and keep on "protesting" against separation.

We found no effect of separation duration on the greeting behavior which is in contrast with a recent study

(Rehn and Keeling, 2011). These authors reported that after longer separation dogs initiated more interaction with the owner and showed more tail-wagging and owner-directed attentive behavior in the post-separation period than after shorter separation. Importantly, in our case the separation time was much shorter.

4.4. Comparison of the behavior of dogs with and without SRD

Stress-related behaviors such as vocalization, scratching of the door, rearing to the wall or door and tail-wagging during separation were more common in affected dogs than in dogs without SRD. The former were also more active during greeting, that is, they preferred to run instead of being in proximity to and contact with the owner. Thus these dogs cannot be easily calmed down by the presence of the owner. In parallel, dogs with owner-reported SRD did not show more affection (e.g. proximity to, body contact (rearing) and eye-contact with the owner and fast tail-wagging) toward the owner at re-union. In line with this Parthasarathy and Crowell-Davis (2006) reported also that dogs with SRD spent equal time in proximity to or contact with the owner in the modified Strange Situation Test than non-affected dogs.

This result is relevant because some authors (e.g. Sherman, 2008) suggested that SRD is a result of the dog's "hyper-attachment" to the owner. According to Appleby and Pluijmakers (2004) hyper-attachment is characterized by staying constantly in proximity to, following and maintaining physical contact with the owner. Hyper-attached dogs express distress when constrained in a room/area detached from the owner, and react with distress behavior to departure cues of the owner. They also greet their owner excessively (Appleby and Pluijmakers, 2004). In a retrospective clinical case record study (Flannigan and Dodman, 2001) found that dogs with SRD were three-five times more likely to follow their owner around the house than dogs with other behavior problems and they also greet their owners excitedly for over 2 min. However, with regard to greeting behavior our result and the finding of Parthasarathy and Crowell-Davis (2006) do not support the view that SRD dogs are hyper-attached to the owner.

Most dogs characterized as having SRD did not spend any time near the owner's chair during separation. Instead, they wanted to escape and resume the contact/proximity with the owner by vocalizing and trying to open the doors or searching for other exits. Prato-Previde et al. (2003) suggest that owners' objects left with the dog may have a calming effect. In their study dogs contacted their owners' clothes more often and for longer durations compared to the stranger's clothes and spent more time near the owner's chair when the owner's objects were present. In our experiment the dog could see the leash and probably smell the owner's scent on the chair. Our observations show that dogs may utilize the owner's objects (and their scent) for reassurance (which is reminiscent to human children who use blankets or toys for reassurance in the absence of the mother). However, dogs with SRD were not attracted by the owners' objects. This may have contributed to the escalation of stress to a level which could not be reduced during the short reunion with the owner.

The above aspects of dogs' behaviors is reminiscent of the insecure-ambivalent ("C"-type) attachment style of human infants who do not use the parent as a secure base, who are very distressed during separation and cannot be easily calmed by the mother at reunion. Several studies (e.g. Warren et al., 1997; Muris et al., 2000) showed that infants with insecure attachment style are more liable to develop anxiety disorders (e.g. separation anxiety disorder). Studies with monkeys and infants suggest that a secure attachment to the parent figure helps the infants mediating the stress response (Kraemer, 1997).

This suggests that we may refer to this type of relationship as being ambivalent (or "insecure") using the terminology of developmental psychology and abandon the concept "hyper-attachment". This latter term does not exist in human developmental psychology and has not yet been defined in terms of behavior.

In the present study dogs with SRD were mostly males. Similar gender proportion was reported by Takeuchi et al. (2001) and McGreevy and Masters (2008). It may be that males and females are equally anxious but owners discover more easily the behavior problem in males because as a consequence of greater body size and strength their destructive behavior and vocalization is more conspicuous.

4.5. Screening for SRD in dogs

Our behavior test was carried out in a laboratory setting, in contrast with former studies in which dogs were filmed at home while alone. There are several reasons why we chose the laboratory setting in addition to the practical reasons (saving time and cost). The laboratory tests can be more controllable and objective, and as we have found (see above) a strange place can provoke separation behavior more easily and intensely, so shorter testing duration is possible. We could use more cameras which may have increased the quality of the behavioral observations. The behavior of the owners is also more controllable. However, it should be investigated how much the behavior of the dog in a laboratory is generalizable to other settings and how relevant it is in connection to SRD. But dogs are often brought to strange places and the laboratory simulates this situation. In addition, we thought that our test can be applied in veterinary offices in the future to diagnose SRD and evaluate treatment efficacy.

5. Conclusion

In conclusion we provided support that our questionnaire reliably indicates dogs' separation-related problem and behaviors associated with separation. Thus it can be a useful device to diagnose SRD in the veterinary practice. For getting a more subtle picture we propose the inclusion of our short behavior test by the means of which the veterinary clinician can get further insights on the dog's specific behavior during separation, e.g. whether their activity during separation endures after minutes, or whether they use

owners' objects for self-reassurance, which may assist the process of correcting such behavioral problems.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.applanim.2011.10.011.

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