



Investigating the bond between research dogs and a familiar person and validation of the Ainsworth's Strange Situation Procedure (ASSP)

Undersökning av bandet mellan försökshundar och en familjär person i Ainsworth's Strange Situation Procedure (ASSP) och utvärdering av testet

Jennichen Svensson

Etologi och djurskyddsprogrammet

**Sveriges lantbruksuniversitet
Institutionen för husdjurens miljö och hälsa
Etologi och djurskyddsprogrammet**

Skara 2010

Studentarbete 322

***Swedish University of Agricultural Sciences
Department of Animal Environment and Health
Ethology and Animal Welfare programme***

Student report 322

ISSN 1652-280X



Investigating the bond between research dogs and a familiar person and validation of the Ainsworth's Strange Situation Procedure (ASSP)

Undersökning av bandet mellan försökshundar och en familjär person i Ainsworth's Strange Situation Procedure (ASSP) och utvärdering av testet

Jennichen Svensson

Studentarbete 322, Skara 2010

Grund C, 15 hp, Etologi och djurskyddsprogrammet, självständigt arbete i biologi, kurskod EX0520

Handledare: Therese Rehn, Sveriges lantbruksuniversitet, Institutionen för husdjurens miljö och hälsa, Box 7068, 750 07 Uppsala, Sverige

Biträdande handledare: Linda Keeling, Sveriges lantbruksuniversitet, Institutionen för husdjurens miljö och hälsa, Box 7068, 750 07 Uppsala, Sverige

Examinator: Harry Blokhuis, Sveriges lantbruksuniversitet, Institutionen för husdjurens miljö och hälsa, Box 7068, 750 07 Uppsala, Sverige

Nyckelord: Ainsworth, Strange situation, dog, attachment

Sveriges lantbruksuniversitet

Fakulteten för veterinärmedicin och husdjursvetenskap

Institutionen för husdjurens miljö och hälsa

Avdelningen för etologi och djurskydd

Box 234, 532 23 SKARA

E-post: hmh@slu.se, **Hemsida:** www.hmh.slu.se

I denna serie publiceras olika typer av studentarbeten, bl.a. examensarbeten, vanligtvis omfattande 7,5-30 hp. Studentarbeten ingår som en obligatorisk del i olika program och syftar till att under handledning ge den studerande träning i att självständigt och på ett vetenskapligt sätt lösa en uppgift. Arbetenas innehåll, resultat och slutsatser bör således bedömas mot denna bakgrund.

Table of contents

ABSTRACT	5
SAMMANFATTNING	6
1. INTRODUCTION.....	7
1.1 Human-dog history	7
1.2 Attachment.....	7
1.3 Ainsworth's Strange Situation Procedure.....	8
1.4 The dog's previous experiences	8
1.5 Aim.....	9
2. MATERIAL AND METHOD	10
2.1 Subjects	10
2.2 Test area	10
2.3 The test	11
2.4 Treatments	11
2.4.1 Treatment FS (Familiar person & Stranger)	11
2.4.2 Treatment SS (Stranger A & Stranger B)	12
2.5 Registration methods	12
2.6 Statistical analysis.....	13
3. RESULTS.....	14
3.1 Treatment FS (Familiar person & Stranger)	14
3.1.1 Secure-base effects	14
3.1.2 Proximity-seeking behaviours	14
3.2 Treatment SS (Stranger A & Stranger B)	14
3.2.1 Secure-base effects	14
3.2.2 Proximity-seeking behaviours	14
3.3 Treatment differences	15
3.3.1 Secure-base effects	15
3.3.2 Proximity-seeking behaviours	15
4. DISCUSSION AND CONCLUSION.....	17

4.1 Treatment FS (Familiar person & Stranger)	17
4.1.1 Secure-base effects	17
4.1.2. Proximity-seeking behaviours	17
4.2 Treatment SS (Stranger A & Stranger B)	18
4.2.1 Secure-base effects	18
4.2.2 Proximity-seeking behaviours	18
4.3 Treatment differences	18
4.3.1 Secure-base effects	18
4.3.2 Proximity-seeking behaviours	18
4.4 Validation of ASSP	19
4.5 Conclusion.....	20
Acknowledgments	20
References	20

ABSTRACT

In the dog-human relationship humans are the ones who provide the dog with safety and comfort. Ainsworth's Strange Situation Procedure (ASSP), which was originally developed in humans to study the relationship between mothers and infants, has been modified to investigate the emotional bond research dogs have to a familiar person. Twelve research dogs were tested to investigate whether the dogs performed any behaviours indicating a secure-base effect, such as more exploration and play in the presence of a familiar person and proximity-seeking behaviours when this person is or has been absent. In the ASSP the dog enters a room with a familiar person, is introduced to a stranger, is left alone for a short period of time and experiences moments of separation and reunion. A second variation of the ASSP was added where the familiar person was replaced by another, to the dog, unfamiliar person. This application of a second treatment has not previously been used and was done to evaluate the test itself. All dogs were tested twice, once in every treatment which both composed of six 3-minute episodes. The results reveal that research dogs show signs of attachment to a familiar person which is recognizable in for instance exploration, play and proximity seeking behavior in different phases of ASSP. The dogs explored and played more when in the company of the familiar person compared to when with a stranger and showed signs of proximity-seeking behaviours when the familiar person was or had been absent. The way that the dogs behaved, support the attachment theory of a secure-base effect and our results, therefore, strongly suggest that ASSP is an appropriate test to use in respect of dogs attachment to humans.

SAMMANFATTNING

I relationen mellan hund och människa är människan ofta den som förser hunden med trygghet och bekvämlighet. Ainsworth's Strange Situation Procedure (ASSP), som ursprungligen utformats för att undersöka det känslomässiga bandet mellan mödrar och små barn, har i den här studien modifierats något för att studera det band som försökshundar har till en familjär person. Tolv försökshundar genomgick testet för att undersöka om hundarna utförde beteenden som till exempel mer utforskande beteenden och lek då den familjära personen är närvarande och mer närhetssökande beteenden då personen är frånvarande, som visar på att den familjära personen utgör en säker bas. I ASSP går hunden in i ett obekant rum med en familjär person, sammanförs med en främling, blir lämnad ensam en kort period och får uppleva stunder av separation och återförening. En andra variation av ASSP lades till och där den familjära personen ersattes med en annan, för hunden, obekant person. Denna tillämpning av en andra behandling har inte tidigare använts och gjordes för att utvärdera testet. Samtliga hundar genomgick testet två gånger, en gång i varje behandling, vilka båda bestod av sex episoder á tre minuter. Resultaten avslöjar att försökshundar visar tecken på att ha detta speciella känslomässiga band till en familjär person som visar sig i t.ex. utforskande beteende, lek och närhetssökande beteende i olika faser av ASSP. Hundarna utforskade och lekte mer i sällskap av den familjära personen i jämförelse med när de var i sällskap av en främling och de uppvisade även tecken på närhetssökande beteenden när den familjära personen var eller hade varit frånvarande. Hundarnas beteende stödjer teorin om att de har ett känslomässigt band med en säker bas och resultaten tyder därför starkt på att ASSP är ett lämpligt test med avseende på hundars känslomässiga band till människan.

1. INTRODUCTION

1.1 Human-dog history

The dog (*Canis familiaris*) was the first species domesticated by humans and through domestication dogs have become less fearful and several situations are perceived as less stressful in comparison to their wild ancestor, the wolf (*Canis lupus*) (Clutton-Brock, 1995). The human-animal relationship involves demands for adaptation which create new conditions of selection within the domestic species and might result in a wider genetic variation (Tópal et al., 2005). Dogs have been bred to serve numerous functions, but the main traits selected for are probably social traits (Clutton-Brock, 1995). Dogs have become increasingly involved in human society working for instance as alert dogs, service dogs, drug-sniffing dogs and have as a result of that developed a close relationship to humans and can be considered as the only species which has established a niche in human society (Nagasawa et al., 2009). The capacity to establish attachment bonds may be a result of domestication (Tópal et al., 2005). Many previous studies of human-dog interactions have focused on people's attachment to their pets, whereas only a few have investigated the level of attachment dogs have to their owners.

1.2 Attachment

An attachment bond is one type of affectional and it lasts over time and is emotionally significant involving a specific individual (Ainsworth, 1989). There is one criterion that distinguishes attachment from other affectional bonds and that is the feeling of comfort and security provided by the relationship which gives the individual (e.g. infant) the courage to confidently leave the secure-base provided by the other individual (e.g. mother) and engage in other activities such as exploration or play (Ainsworth, 1989). One basic feature of attachment is the capability to distinguish a particular individual from others (Ainsworth, 1989; Bowlby, 1958). The attachment bond is an asymmetrical relationship between only two individuals (Topál et al., 2005). Individuals with an attachment bond want to stay close to each other and become anxious when involuntarily separated (Ainsworth, 1989). An attachment bond is a unique bond and the individual involved is not wholly replaceable by another (Ainsworth, 1989). Other species studied referring to the ethological aspect of attachment are for example macaque (Harlow & Zimmermann, 1959) and chimpanzee (Bard, 1991).

In the human-dog relationship humans are the ones who provide the dog with safety and comfort and act as a secure-base, allowing the dog to engage in other activities such as exploration and play (Topál et al., 1998). The dog-owner relationship resembles in many aspects the mother-infant relationship in humans (Prato Previde et al., 2003). Previous studies have shown that dogs can separate specific humans, such as their owner, from other people (Nagasawa et al., 2009) and from the literature there is evidence that research animals can distinguish between familiar and unfamiliar caretakers (Hosey, 2008). According to Valsecchi et al. (2010) there are four circumstances that may affect the development of an attachment bond in dogs in a negative way; an early separation from mother and litter mates, incorrect interaction from the owner/caregiver, lack of opportunities to express, what is for the dog, species-specific behaviours and a morphological focus in the breeders' selection. According to Prato-Previde et al. (2003) the bond between the dog and its caregiver/owner is a strong bond and the dog shows the same

type of behaviour at separation from its owner/caregiver as infants show when separated from their mothers during ASSP.

1.3 Ainsworth's Strange Situation Procedure

Ainsworth's Strange Situation Procedure (ASSP) is a test originally developed to investigate the affectional bond between infant and mother in humans, by studying the behaviours indicating a secure-base effect. The behaviours in focus are exploration, play, passive behaviours and proximity-seeking behaviours (e.g. physical contact and vocalization). A secure-base effect means that the mother provides comfort and security which allows the child to confidently engage in other activities (Ainsworth, 1989). Behaviours indicative of a secure-base are more exploration and play when the familiar person is present and more proximity-seeking behaviours when this person is absent and at the time of reunion after a short period of separation. Though passive behaviour is one of the behaviours in focus of the ASSP, a passive dog is not for certain a calm, relaxed and confident dog, it could be an expression of passive coping. A study focusing on heart rate and behavioural response in dogs using ASSP (Palestrini et al., 2005) showed that low motor activity was not always linked to a low heart rate and the results therefore suggest that low motor activity could be a way of coping with a stressful situation. Another study made on the behaviours and heart rate of dogs in a novel situation (Gácsi et al., 2009) showed that the dogs had lower heart rate due to a secure-base effect when in the company of the caregiver, who usually is the owner. ASSP has been used in a variety of ways in previous studies on dogs, but the principle is the same. In the ASSP the dog enters a room with a familiar person, is introduced to a stranger, is left alone for a short period of time and experiences moments of separation and reunion. ASSP has been used in previous studies to investigate the bond between a dog and its owner (Topál et al., 1998; Prato Previde et al., 2003; Palestrini et al., 2005; Topál et al., 2005; Palmer & Custance, 2008; Lindholm, 2009; Valsecchi et al., 2010) and where results indicate that a dog forms a special bond to its caregiver or owner. Prato Previde et al. (2003), Palmer and Custance (2008) and Lindholm (2009) have also found results of a secure-base effect and have come to the conclusion that dogs may establish an attachment bond to a person. In this study ASSP has been used to study the affectional bond research dogs have to a familiar person.

1.4 The dog's previous experiences

Research dogs are not reared under the same conditions as pet dogs and it is well known that the dog's previous experiences are crucial in terms of the dog's behaviour in different situations. Pups that have been handled from an early age are less susceptible to emotional perturbations and adapt more easily to new or novel situations (Fox & Stelzner, 1966). Socialization and early experience has a great influence on the development and behaviour of the adult dog (Battaglia, 2009). However, in the aspect of attachment, Topál et al. (2005) found that extensive socialization by the human caregiver had minimal impact on the attachment behaviour of dogs. These dogs were tested at 16 weeks of age but according to Valsecchi et al. (2010) dogs do not reach a complete physical and cognitive maturity until they are two years old and results from the same study shows that an attachment bond does not clearly appear in dogs until they are about 36 months of age. Another study (Gácsi & Topál, 2001) showed that although attachment might be associated with the dog's sensitive periods, attachment behaviours in dogs that are more than one year old and that have had depressed level of contact with humans may occur only after three short interactions with an unfamiliar person. Fallani et al. (2006) found that despite separation from a previous

attachment figure, guide dogs displayed the same register of proximity-seeking behaviours towards their owner as observed in pet dogs. Prato Previde & Valsecchi (2007) found though, that dogs who have had different owners may establish a strong affectional bond to its new owner but this new bond does presumably not yield the same security to the dog.

1.5 Aim

Compared to pet dogs, research dogs are housed in another way, spend less time with a specific person and have other daily activities. The aim of this study was to investigate if the relationship research dogs have to a familiar person is an attachment bond.

My hypothesis for treatment FS (Familiar person & Stranger) is that research dogs show signs of attachment to a familiar person because the familiar person acts as a secure base for the dog in the ASSP. The dog (1) explores more when the familiar person is present in the room compared to when the familiar person is absent (2) plays more when the familiar person is present in the room and (3) shows signs of proximity-seeking behaviours when the familiar person is or has been absent from the room.

In the second treatment, SS (Stranger A and Stranger B), the familiar person is replaced by a stranger (A). This application of the ASSP has not been done previously and the reason to include a second treatment is to see if the test really shows what it is supposed to show, that is, if the dog may establish an attachment bond to a familiar person. If the results show that the dogs do not behave differently when with a familiar person compared to when this person has been exchanged to a stranger, ASSP may not be the correct test to use in respect of dogs' attachment to humans.

My hypothesis for treatment SS (Stranger A & Stranger B) is that research dogs do not show any signs of attachment to stranger A because this person does not provide a secure base for the dog. The dog (1) does not explore more when stranger A is present in the room compared to when stranger A is absent (2) does not play more when stranger A is present in the room and (3) the dog does not show any signs of proximity-seeking behaviours when stranger A is or has been absent from the room.

My hypotheses when comparing the results between the two different treatments are that (1) the dogs will behave differently in episodes where the familiar person has been exchanged into stranger A and (2) the dogs will behave in the same way in episodes that always include a stranger in the two treatments.

2. MATERIAL AND METHOD

2.1 Subjects

We used twelve research dogs that were kept at the Swedish University of Agricultural Sciences in Uppsala, Sweden, and owned by the Department of Animal Environment and Health (HMH). They were of the breed beagle and all of them were intact bitches. At the time of the study the dogs had been in Sweden for about one year and four months and were about two years old.

They were housed in stable groups with three animals in each group. Between 8.00 am and 3.30 pm the dogs were housed outside, in large groups divided in terms of gender, in large dog exercise areas which had several kennels and all the dogs could have visual contact with each other. The dogs were fed individually indoors twice a day, around 7.30 am and 4.00 pm. The dog exercise areas were cleaned once a week and the indoor enclosures were cleaned daily. The dogs were walked regularly outside the kennels. During the test period the dogs were cared for according to prevailing routines but removed from the group during the tests and were afterwards directly brought back to its group.

This study included five people with different roles. Two people were familiar with the dogs and participated as the familiar person for six dogs each in the FS treatment. The familiar persons were both women who had spent regular, but different amounts of, time with the dogs during their stay in Sweden and all meetings have taken place during positive circumstances. The dogs had participated in other studies previously, concerning positive feelings in dogs during which they were handled by these familiar persons. A third person acted as the stranger in treatment FS and two other persons were acting as Stranger A and Stranger B in the SS treatment. The women acting as strangers were accustomed to dogs but had never met these specific dogs before. All women involved were between 20 and 40 years old at the time of the test.

2.2 Test area

The study was done at the Swedish University of Agricultural Sciences in Uppsala, Sweden, in 2009. Both treatments took place in the same room (Figure 1) which was 5.9 m long and 2.9 m wide, connected with a smaller square shaped room with a length and width of 2.9 m. The room was equipped with two wireless cameras for monitoring (Vivotek network camera PT3124) and one digital video camera (SONY HDR-SR10E), which was placed at dog level. In the room there were also two chairs, a dog toy and a water bowl. The two chairs were placed at an equal distance to the entrance door and faced towards each other. The larger room was split in five zones with black tape to easily be able to determine where in the room the dogs were at every sample point. The zone closest to the door was named 'near door'. The zone with the water bowl and the zone with the dog toys were named 'neutral zone'. The zone where the owner had her chair was named 'owner zone' and the zone where the stranger had her chair was named 'stranger zone'. The smaller connecting room was completely empty and none of the rooms had any windows. After every test the room was carefully cleaned and disinfected. The water bowl was washed and refilled with fresh water.

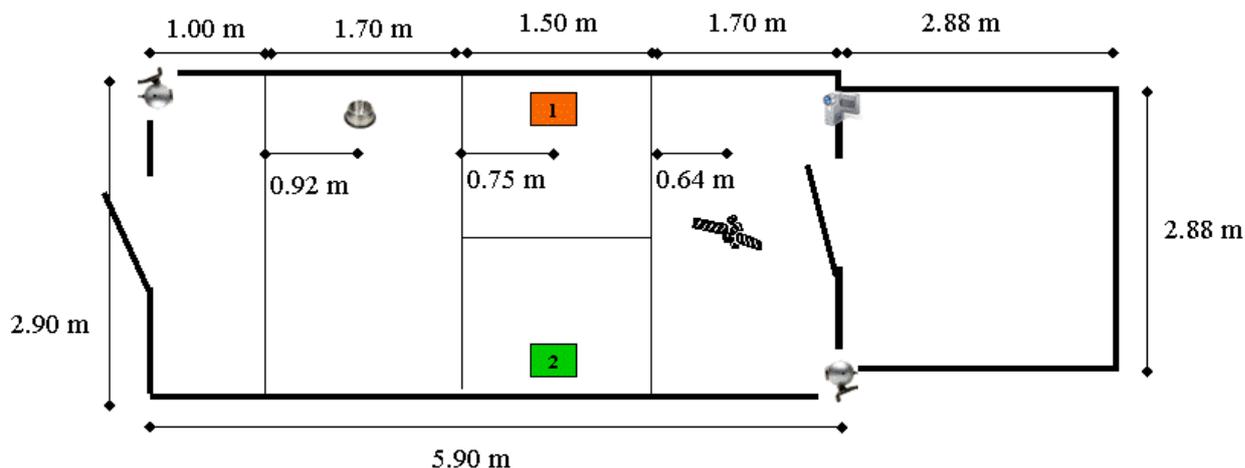


Figure 1. Overview of the test area. The black lines represent the tape on the floor that divided the larger room in five zones. The rectangles with numbers (1 and 2) represent the two chairs, the water bowl shows where the water bowl was placed and the rope represents the area where the dog toy was placed. The entrance/exit door is the one to the left in the image. The smaller adjacent room, to the right in the image, was empty and was available to the dog from episode 4.

2.3 The test

This study was approved by the Swedish Ethical Committee with application reference no: C242/8.

In this study ASSP consists of six consecutive 3 minute long episodes (total of 18 minutes) and two different variations of the ASSP were applied. The dogs were tested individually and twice, once in each treatment (Table 1) and the treatments were balanced to exclude the order effects of the ASSP. Six dogs started with treatment FS and six dogs started with treatment SS. The dogs were tested at the same time of day in both treatments. In the group of dogs there were four pairs of sisters. They were balanced between treatments and time (am or pm). The dogs had seven days in between the two treatments. The same ethogram as in a previous study (Lindholm, 2009) made on private owned pet dogs was used, but with some minor modifications (App 1) and a total of 34 behaviours and locations were recorded.

2.4 Treatments

2.4.1 Treatment FS (Familiar person & Stranger)

In treatment FS the dogs entered an unfamiliar room together with a familiar person who sat down on her chair and stayed passive. In episode 2, a stranger entered the room and sat down on the other chair and remained passive. After one minute the familiar person and the stranger started a conversation that lasted for one minute. Then the stranger, while seated on the floor, initiated play with the dog with a tug toy and after another minute the familiar person left the room, leaving the dog with the stranger. If the dog stopped playing when the familiar person left, the stranger initiated play again, and if the dog wanted to, the play lasted throughout episode 3. The stranger initiated play only for 45 sec and if the dog did not want to play, the stranger offered comfort (stroked the dog) for 15 sec then sat down quietly in her chair again. At the end of episode 3, the stranger opened the door to the smaller adjacent room and then left the test room. In episode 4, the dog was left alone in

the room, with access to the smaller connecting room. After three minutes of being alone the familiar person returned, greeted the dog for 10 sec and then stayed passive on the chair. In the last episode, the stranger returned, greeted the dog if it approached then walked to her chair and stayed passive. As soon as the stranger sat down, the familiar person left the room leaving the dog and stranger. Throughout the test the participating persons were allowed to stroke the dog once if it sought contact (e.g. if jumping up with its front paws in the person's lap).

2.4.2 Treatment SS (Stranger A & Stranger B)

The second treatment, SS (Stranger A & Stranger B), has not yet been studied previously and was added to evaluate the test itself. In treatment SS the familiar person was replaced by another, to the dog, unfamiliar person (Stranger A). Another unfamiliar person, Stranger B, acted as a second stranger in SS. The procedure of the test was exactly the same as in FS, but in this treatment, only strangers interacted with the dogs and no familiar person was ever present. For the sake of simplicity, when making comparisons between or within treatments, I will from now on discriminate between the familiar person (F) and a stranger (S) in FS and refer to stranger A (S_A) and stranger B (S_B) in treatment SS.

Table 1. Episode overview of the two different treatments in a modified version of Ainsworth's Strange Situation Procedure

Episode	Treatment FS	Treatment SS	Event
1	D + F	D + S_A	F (S_A) passive
2	D + F + S	D + S_A + S_B	F (S_A) passive, S (S_B) initiate play with dog
3	D + S	D + S_B	S (S_B) initiates play with dog
4	D	D	Dog alone
5	D + F	D + S_A	Reunion F (S_A), then passive
6	D + S	D + S_B	Reunion S (S_B), F (S_A) leaving, S_B passive

Key: D = dog, F = familiar person (FS), S = stranger (FS) & S_A = stranger A (SS), S_B = stranger B (SS)

2.5 Registration methods

The dogs were videotaped during all tests and episodes and registration began when the person who first entered the room with the dog sat down on her chair. The chair that belonged to whom was balanced. Six dogs always had the familiar person/stranger A sitting in the chair located at one side of the room and the other six dogs always had them on the other side of the room, to avoid possible location preference. Two observers analyzed twelve video tapes each, six from treatment FS and six from treatment SS to avoid that the results would depend on the observer. The order in which they were observed was also balanced in the sense that videotapes from the two treatments were observed alternately. Instantaneous/point sampling and continuous sampling was used with an interval of five seconds for both methods. For behaviours with long duration (App 1) instantaneous/point sampling was used and for behaviours with short duration 1/0 registration was used so that these behaviours would not be missed. For lip licking continuous sampling was used. Four video tapes (approximately 17% of the material) were

analyzed by both observers and inter observer agreement was always above 86% (86%-100%).

2.6 Statistical analysis

Behaviours that previously have been used to indicate a secure-base effect according to the attachment theory (exploration and play) (Prato Previde et al., 2003; Palmer & Custance, 2008; Lindholm, 2009) and some selected proximity-seeking behaviours (vocalization, physical contact, location near door, oriented to door and contact door) (Prato Previde et al., 2003; Palmer & Custance, 2008; Lindholm, 2009) were analyzed. The dogs made some different sounds (bark and whine) and they were both included into a new category named vocalization.

To analyze behaviours within treatments comparisons between episode 5 (D + F/S_A) and episode 6 (D + S/S_B) were most frequently done and has also been used in previous studies (Lindholm, 2009). These two episodes were most similar according to the events happening within them (Table 1) and seem to be a fair comparison between two episodes. When comparing the effect the presence of a familiar person had on the dogs' behaviour within treatment FS, episode 5 (D + F) and 6 (D + S) were compared. The same comparison was made in SS with the assumption that no differences would be observed considering that the dog was accompanied by a stranger in both episode 5 (D + S_A) and episode 6 (D + S_B). To further investigate the effect of a familiar person, comparisons between treatments, mainly made in episode 5, where the familiar person was present in FS and stranger A was present in SS was done. Episode 1, 2 and 5 were also compared as a group, between treatments, where the familiar person was present in the FS treatment and Stranger A was present in the SS treatment. When comparing vocalization, episodes 1 and 5 (familiar person present) and episode 3 and 6 (stranger A present) were selected based on comparisons made by Lindholm (2009), to be able to draw conclusions between the two studies.

The collected data was put in Microsoft Excel and analyzed in MiniTab. The data was not normally distributed and therefore the non-parametric Kruskal-Wallis rank sum test was used to test statistical significance.

3. RESULTS

3.1 Treatment FS (Familiar person & Stranger)

3.1.1 Secure-base effects

The mean time spent on exploration decreased from 0.23 in episode 1 to 0.06 in episode 6 but increased in episode 3 and 5. Compared to when with the familiar person (episode 5; 0.16 ± 0.02 (mean \pm SE)) versus with a stranger (episode 6; 0.06 ± 0.01) the research dogs spent significantly more time exploring when with the familiar person (Table 3). The dogs did not play significantly ($p=0.41$) more when with the familiar person (episode 5; 0.10 ± 0.01) compared to when with a stranger (episode 6; 0.07 ± 0.01).

3.1.2 Proximity-seeking behaviours

When comparing any type of vocalization when dogs were with the familiar person (episode 1 + 5; 0.03 ± 0.01) and a stranger (episode 3 + 6; 0.04 ± 0.01) the results were not significantly different ($p = 0.84$). The dogs were significantly ($p = 0.01$) more oriented to door when with a stranger (episode 6; 0.18 ± 0.02) than when with the familiar person (episode 5; 0.07 ± 0.01) but there were no significant difference in the aspect of either 'location near door' ($p = 0.95$) or 'contact with door' ($p = 0.95$).

3.2 Treatment SS (Stranger A & Stranger B)

3.2.1 Secure-base effects

The dogs did not explore significantly more ($p = 0.24$) in either episode 5 (0.09 ± 0.01) nor episode 6 (0.04 ± 0.01). There was no significant difference ($p = 0.16$) in respect of play either for episode 5 (0.01 ± 0.00) or episode 6 (0.06 ± 0.01).

3.2.2 Proximity-seeking behaviours

The mean of physical contact when reunited with stranger A (episode 5) and stranger B (episode 6) after a short period of separation was $0.12 (\pm 0.02)$ and $0.11 (\pm 0.01)$ respectively. When comparing any type of vocalization when the dogs were with stranger

Table 2. Summary of results from Kruskal-Wallis test within treatments

Behaviour	Comparisons	Result FS	Result SS
Secure base effects			
Exploration	Ep 5 (D+F/S _A) vs. Ep 6 (D+S/S _B)	$p = 0.01$	ns
Independent play	Ep 5 (D+F/S _A) vs. Ep 6 (D+S/S _B)	ns	ns
Proximity-seeking			
Vocalisation	Ep 1+5 (D+F/S _A) vs. Ep 3+6 (D+S/S _B)	ns	ns
Location near door	Ep 5 (D+F/S _A) vs. Ep 6 (D+S/S _B)	ns	ns
Oriented door	Ep 5 (D+F/S _A) vs. Ep 6 (D+S/S _B)	$p = 0.01$	ns
Contact door	Ep 5 (D+F/S _A) vs. Ep 6 (D+S/S _B)	ns	ns

Key: Ep = Episode, D = dog, F = Familiar person, S = Stranger, SA = Stranger A, SB = Stranger B, ns = non significant ($p > 0.05$)

A in episodes 1 + 5 (0.02 ± 0.00) or stranger B in episodes 3 + 6 (0.02 ± 0.01) the results were not significant ($p=0.93$). Between episode 5 (D + S_A) and episode 6 (D + S_B) there was no significant difference with respect to 'location near door' ($p = 0.60$), 'oriented to door' ($p = 0.87$) nor 'contact with door' ($p = 1.00$).

3.3 Treatment differences

3.3.1 Secure-base effects

The dogs did not explore significantly more ($p = 0.08$) in treatment FS when comparing all episodes of the two different treatments but there was a tendency to be a difference between the treatments. The amount of time the research dogs explored in episode 5 in the two different treatments was significantly higher in treatment FS ($p=0.05$, FS: 0.16 ± 0.02 , SS: 0.09 ± 0.01) but in episode 6 the amount of time was not significantly different ($p = 0.59$, FS: 0.06 ± 0.01 , SS: 0.04 ± 0.01) (Figure 2 and Table 2). Since the dogs rarely engaged in social play (32 data points of 5192 possible) only data from individual play was analyzed. The research dogs played more in the presence of the familiar person than in the presence of a stranger during episode 5 ($p=0.01$, FS: 0.10 ± 0.01 , SS: 0.01 ± 0.00) in the two different treatments.

3.3.2 Proximity-seeking behaviours

The dogs spent significantly more time in physical contact with the familiar person than a stranger ($p=0.03$), when reunited after a short period of separation (episode 5; FS: 0.21 ± 0.02 , SS: 0.12 ± 0.02). When comparing the episodes when the familiar person was present in FS (episode 1, 2 and 5) with the same episodes in SS the dogs still spent more time in physical contact with the familiar person than the stranger ($p = 0.04$). When comparing vocalization in the episodes when the familiar person was present in FS (episode 1, 2 + 5) with the same episodes in SS ($p = 0.42$). Nor was there any significant difference when comparing 'location near door' ($p = 0.95$, FS: 0.17 ± 0.02 , SS: 0.17 ± 0.02), 'oriented to door' ($p = 0.30$, FS: 0.07 ± 0.01 , SS: 0.11 ± 0.02) and 'contact with door' ($p= 0.95$, FS: 0.00 ± 0.00 , SS: 0.00 ± 0.00) in episode 5 in the two different treatments.

Table 3. Summary of results from Kruskal-Wallis test, comparing the two treatments

Behaviour	Comparisons	Result
Secure-base effects		
Exploration	Ep 5 (D+F) vs. Ep 5 (D+S _A)	$p=0,05$
Independent play	Ep 5 (D+F) vs. Ep 5 (D+S _A)	$p=0,01$
Proximity-seeking		
Contact person	Ep 5 (D+F) vs. Ep 5 (D+S _A)	$p=0,03$
	Ep 1+2+5 (D+F) vs. Ep 1+2+5 (D+S _A)	$p=0.04$
Vocalisation	Ep 1+2+5 (D+F) vs. Ep 1+2+5 (D+S _A)	ns
Location near door	Ep 5 (D+F) vs. Ep 5 (D+S _A)	ns
Oriented door	Ep 5 (D+F) vs. Ep 5 (D+S _A)	ns
Contact door	Ep 5 (D+F) vs. Ep 5 (D+S _A)	ns

Key: Ep = Episode, D = dog, F = Familiar person, S_A = Stranger A, ns = non significant ($p > 0.05$)

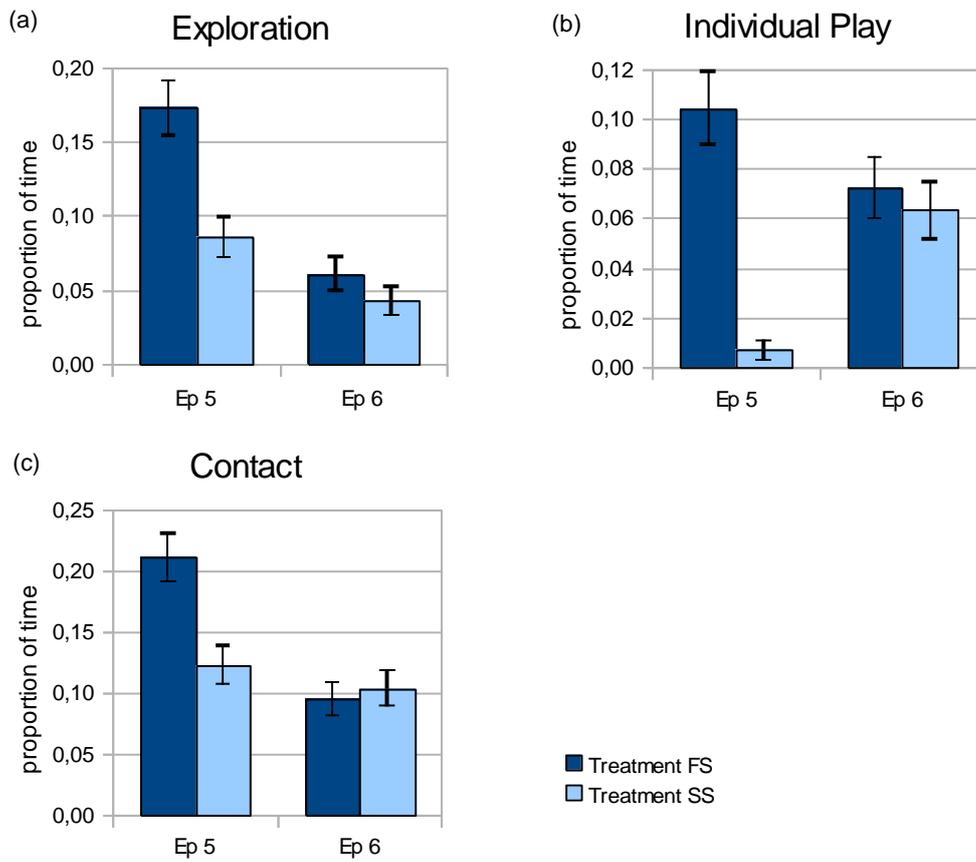


Figure 2. The amount of time research dogs (a) explore, (b) play, and stay in (c) physical contact with a human when reunited after a short separation, in the presence of the familiar person (treatment FS in episode 5) and in the presence of a stranger (treatment SS in episode 5 and both treatments in episode 6) in the Ainsworth's Strange Situation Procedure.

4. DISCUSSION AND CONCLUSION

As predicted, the results indicate that research dogs show signs of attachment to a familiar person since behaviours (play, exploration and proximity-seeking) demonstrate that this individual acts as a secure-base for the dog in the ASSP. This is demonstrated by the fact that the dogs explore and engage more in play when in the company of the familiar person and show signs of proximity-seeking behaviours when this person is absent. The results also indicate that the dogs do not have an attachment to a stranger since signs of a secure-base are lacking during the ASSP. There is no difference in the aspect of either exploration or play when any of the strangers are present and the dogs do not show signs of proximity-seeking behaviours when the strangers are absent.

Passive behaviours were excluded because of the fact that one might not, just by looking at the dog, be sure that the dog is in a relaxed state of mind or if it expresses a way of coping with a stressful situation. Palmer and Custans (2008) did not find any significant difference neither within, nor between, the two counterbalanced versions of the ASSP in the aspect of passive behaviour. Another study (Lindholm, 2009) showed the same results in the aspect of passive behavior when comparing episode 5 and episode 6 within treatment.

On the other hand, when combining data from both treatments (Palmer & Custance, 2008) the dogs were significantly more passive in the company of the owner. Prato-Previde (2003) found the same results when comparing episodes where only the owner was present with episodes where only the stranger was present.

4.1 Treatment FS (Familiar person & Stranger)

4.1.1 Secure-base effects

The secure-base is demonstrated by a greater extend of exploration and the increase of exploration in episode 5 shows that the dogs felt more confident than in episode 4, when alone. The increase of exploration in episode 3 could be a result of the fact that the dogs did not understand the human's signals and invitations to play and therefore tried to calm the person by wandering off and explore the room. The dogs explored more when with the familiar person within treatment but did not play significantly more in episode 5, when in the company of the familiar person, compared to episode 6, when with a stranger. The non significant result in the aspect of play is likely an effect from a very large variation between the dogs in this study.

4.1.2. Proximity-seeking behaviours

The results show that the dogs were significantly more oriented towards the door when in the company of a stranger than when with the familiar person. As when comparing the two treatments vocalization was about the same when the dogs were with a familiar person or with a stranger. There was no significant difference between episodes 1 + 5 (D+F) and 3 + 6 (D+S) in respect of vocalization. This might be due to the fact that all sounds were analyzed together as a group, but different sounds have different meanings. Dogs bark in many different situations: when greeting, during play, as a threat and when aggressive (Bleicher, 1963). In the same study Bleicher found that a yelp-like whine indicated a great stress, like being in pain or being afraid, while bark-like yelps occurred during play-fights. The study also showed that the growl is used both as a threat and during play. No

separation between sounds were made and the non significant result between the episodes might be due to that. There was no significant difference between 'location near door' and 'contact with door'.

4.2 Treatment SS (Stranger A & Stranger B)

4.2.1 Secure-base effects

The dogs did not favor any of the strangers in the aspect of exploration or play which corroborates the theory that the strangers did not provide a secure-base to the dog.

4.2.2 Proximity-seeking behaviours

Nor in this treatment was there any difference in vocalization. There was no significant difference between episode 5 (D+S_A) and episode 6 (D+S_B) with respect to 'location near door', 'oriented to door' or 'contact with door' either.

4.3 Treatment differences

To further investigate the effect of a familiar person, comparisons between treatments, mainly made in episode 5, where the familiar person was present in FS and stranger A was present in SS was done. The benefits of being able to do this comparison are for example the fact that the episode falls on the same time into the test and that the circumstances three minutes prior to the episodes (dog alone) are the same in both treatments. Comparisons between treatments give a more accurate picture when studying the influence a familiar person has on the dog's behaviour compared to a stranger. An equally good comparison between episodes can not be done within treatment.

4.3.1 Secure-base effects

To give the dogs the opportunity to express explorative behaviour throughout the test they were given access to an additional room at the end of episode 3. The results show that the familiar person acted as a secure-base to the dogs, which could engage in exploration to a greater extent than when they were with a stranger. The dogs seldom engaged in social play which is probably a result of the way they have been handled during their adolescence and their current living conditions. Contact with humans has never included a lot of social play for these dogs and therefore the dogs were probably quite unfamiliar to this type of interaction. Prato Previde and Valsecchi (2007) found in their study the importance that the contact and interactions between the dog and the human individual are regular and last over time to establish an attachment bond. This appeared among others in the fact that dogs that had lived with the same family since puppy stage played more, both when the familiar person was present and absent during ASSP, unlike dogs that had had different owners or lived at a shelter (Prato Previde & Valsecchi, 2007). Despite that the research dogs rarely engaged in social play they were more willing to play individually and they were more engaged in individual play in the presence of the familiar person than a stranger, which speaks for a secure-base effect. Previous studies (Prato Previde et al., 2003; Palmer & Custance 2008; Lindholm 2009) have also found the same results of a secure-base effect.

4.3.2 Proximity-seeking behaviours

The most interesting part in the aspect of physical contact is the reunion after a short period of separation. Because the results show that the dogs are significantly more willing to be in

physical contact with the familiar person than a stranger after separation implies that the dogs have an attachment bond to the familiar person in the ASSP. There was no significant difference when comparing 'location near door', 'oriented to door' and 'contact with door' in the two different treatments.

4.4 Validation of ASSP

Our results strongly suggest that ASSP is an appropriate test to use in respect of dogs attachment to humans because the way that the dogs behaved supports the attachment theory of a secure-base effect. The dogs explored more when in the company of a familiar person than when with a stranger, both within the FS treatment (episodes 5 vs. episode 6) and between treatments (episode 5), which shows that the familiar person acted as a secure-base to the dog in the FS treatment and the strangers did not in the SS treatment.

The dogs also played more when in the company of a familiar person in episode 5 when comparing the two treatments. On the other hand, the dogs did not play significantly more in the presence of a familiar person (episode 5 vs. episode 6) in the FS treatment, which could have been expected. There was no significant difference in play (episode 5 vs. episode 6) in the SS treatment, which suggests that the familiar person acted as a secure-base to the dogs in the FS treatment.

When comparing all episodes when the familiar person was present (episode 1+2+5) with the same episodes in treatment SS the dogs were more willing to stay in physical contact with the familiar person than stranger A. This was the case when comparing episode 5 (FS: D+F, SS: D+S_A) too, when reunited after a short period of separation.

There was no significant difference between episode 5 and episode 6 in the SS treatment with respect to 'location near door', 'oriented to door' and 'contact with door' which shows that the dogs did not prefer any of the strangers. What speaks against ASSP in these respects is the fact that there was no significant difference between these categories in the FS treatment either, except from 'oriented to door'. Nor was there any significant difference when comparing 'location near door', 'oriented to door' and 'contact with door' in the two different treatments. However, a counterbalanced version of the ASSP made by Palmer and Custance (2008) showed that the dogs spent significantly more time located near door, when the owner was absent, when comparing episode 5 and episode 6 in the two treatments. Linholm (2009) also found that the dogs were significantly more located near door when separated from the owner compared to when separated from a stranger. The reason why their results differ from our results could be due to the fact that both Palmer and Custance (2008) and Lindholm (2009) used privately owned dogs and their respective owners. The relationship between dog and owner is probably somewhat different from the one between research dogs and a familiar person and therefore the pet dogs acted differently from the research dogs. It could be a result from daily routines where the privately owned dogs are used to a close contact with, and spend a lot of time with, their owner. The separation from owner in this new environment was presumably stressful but the dogs might have learned that the owner will return, and through the same door he or she left through, and therefore waited near the door. Ginsburg and Hiestand (1992) stated that the dog's breed, rearing conditions and previous experiences effect the individual's reaction to humans and could be an explanation to the different results when comparing studies made on pet dogs with ones made on research dogs.

4.5 Conclusion

The results strengthen my hypothesis that research dogs show signs of attachment to a familiar person during ASSP because the familiar person acts as a secure-base for the dog. Like the theory, the dogs explored and played more in the presence of the familiar person compared to when in the company of a stranger and showed signs of proximity-seeking behaviours when the familiar person was not in the room. The dogs also spent more time in contact with the familiar person than a stranger when reunited after a short period of separation.

This means that it does not require a close relationship, as pet dogs have to its owner, for a dog to establish an attachment bond to a person. The results highlight the importance of continuous social contact with the same human, over a longer period of time, for research dogs. The presence of an attachment figure during testing would most certainly lead to calmer research dogs which feel safe and secure in those kinds of situations. It would be interesting to use this test on privately owned dogs too, since there seems to be some minor behavioral differences between them and research dogs, due to their living conditions and our results invite further investigations in the aspect of dog-human relationships. It is essential to get a deeper understanding of the relationship that research dogs establish with humans in their vicinity since more knowledge hopefully leads to an increased welfare for the dogs.

Acknowledgments

I would like to thank Linda Keeling and the Department of Animal Environment and Health (HMH) at the Swedish University of Agricultural Science in Uppsala for letting me use their data. I also would like to thank Linda Keeling for valuable remarks for improvements of the report during the study's final phase. My greatest thanks goes to my supervisor Therese Rehn for her commitment, support and encouragement during the whole process of making this report.

References

- Ainsworth, M. D., 1989. Attachments beyond infancy. *American Psychologist*. 44, 709-716.
- Bard, K. A., 1991. Distribution of attachment classifications in nursery chimpanzees. *American Journal of Primatology*. 24, 88.
- Battaglia, C. L., 2009. Periods of early development and the effects of stimulation and social experience in the canine. *Journal of Veterinary Behavior*. 4, 203-210.
- Bleicher, N., 1963. Physical and behavioral analysis of dog vocalizations. *American Journal of Veterinary Research*. 24, 415-427.
- Bowlby, J., 1958. The nature of the child's tie to his mother. *The international Journal of Psycho-analysis: and Bulletin of the International Psycho-analytical Association*. 39, 350-373.
- Clutton-Brock, J., 1995. Origin of the dog: domestication and early history. In: *The domestic dog: its evolution, behaviour and interactions with people*. (Ed. J. Serpell). Cambridge, Cambridge University Press.
- Fallani, G., Prato Previde, E., Valsecchi, P., 2006. Do disrupted early attachment affect the

- relationship between guide dogs and blind owners? *Applied Animal Behaviour Science*. 100, 241-257.
- Fox, M. W., Stelzner, D., 1966. Behavioural effects of differential early experience in the dog. *Animal Behaviour*. 14, 273-281.
- Gácsi, M., Topál, J., 2001. Attachment behavior of adult dogs (*Canis familiaris*) living at rescue centers: forming new bonds. *Journal of Comparative Psychology*. 115, 423-431.
- Gácsi, M., Maros, K., Sernkvist, S., Miklósi, Á., 2009. Does the owner provide a secure base? Behavioral and heart rate response to a threatening stranger and to separation in dogs. *Journal of Veterinary Behavior*. 4, 90-91.
- Ginsburg, B. E., Hiestand, L., 1992. Humanity's "best friend": the origins of our inevitable bond with dogs. In: *The inevitable bond, examining scientist-animal interactions*. (Eds. H. Davis, D. Balfour). Cambridge, Cambridge University Press.
- Harlow, H. F., Zimmermann, R. R., 1959. Affectional responses in the infant monkey. *Science*. 130, 421-432.
- Hosey, G., 2008. A preliminary model of human-animal relationships in the zoo. *Applied Animal Behaviour Science*. 109, 105-127.
- Lindholm, U., 2009. The dynamics in the dog-owner relationship – is there a correlation between owners' and dogs' bonds to each other? Master thesis, Dept of Large Animal Science, Faculty of Life Science, Copenhagen University, Denmark.
- Nagasawa, M., Mogi, K., Kikusui, T., 2009. Attachment between humans and dogs. *Japanese Psychological Research*. 51, 209-221.
- Palestrini, C., Prato-Previde, E., Spiezio, C., Verga, M., 2005. Heart rate and behavioural responses of dogs in the Ainsworth's Strange Situation: A pilot study. *Applied Animal Behaviour Science*. 94, 75-88.
- Palmer, R., Custance, D., 2008. A counterbalanced version of Ainsworth's Strange Situation Procedure reveals secure-base effects in dog-human relationships. *Applied Animal Behaviour Science*. 109, 306-319.
- Prato-Previde, E., Valsecchi, P., 2007. Effect of abandonment on attachment behavior of adult pet dogs. *Journal of Veterinary Behavior*. 2, 87-88.
- Prato-Previde, E., Custance, D. M., Spiezio, C., Sabatini, F., 2003. Is the dog-human relationship an attachment bond? An observational study using Ainsworth's Strange Situation. *Behaviour*. 140, 225-254.
- Topál, J., Gácsi, M., Miklósi, Á., Virányi, Z., 2005. Attachment to humans: a comparative study on hand-reared wolves and differently socialized dog puppies. *Animal Behaviour*. 70, 1367-1375.
- Topál, J., Miklósi, Á., Csányi, V., Dóka, A., 1998. Attachment behaviours in dogs (*Canis familiaris*): A new application of Ainsworth's (1969) strange situation test. *Journal of Comparative Psychology*. 112, 219-229.
- Valsecchi, P., Prato-Previde, E., Accorsi, P. A., Fallani, G., 2010. Development of the attachment bond in guide dogs. *Applied Animal Behaviour Science*. 123, 43-50.

Appendix 1

ETHOGRAM – Ainsworth’s Strange Situation Procedure (research dogs)

5 second interval Instantaneous sampling

Location:

N.D = near door => 50 % of the dog’s body is located in the zone closest to the door.

N.Z = neutral zone => 50 % of the dog’s body is located in one of the two neutral zones.

N.O = near owner => 50 % of the dog’s body is located in the zone around the owners chair.

N.S = near stranger => 50 % of the dog’s body is located in the zone around the strangers chair.

R2 = room 2 => 50 % of the dog’s body is located in room 2.

If the dog is located in two or three areas at the same time the location will be counted as the area in which most of the dog’s body is situated.

If the dog’s body is situated equally in two or three areas then the location will be counted as the area in which the dog is moving towards.

Main behaviour:

SI = sitting; the dog is sitting up with its front legs extended and the hind legs curved.

LY = lying; the dog is lying down.

ST = standing; the dog is standing up on all four paws or up on hind legs resting front paws on person/furniture/other, hind paws on the floor.

WK = walking; the dog is walking around, moving.

RN = running; the dog is running around (trotting or galloping).

Secondary behaviour:

HEAD DOWN WHEN LYING

The dog’s head is resting on the floor while the dog is in lying position.

EXPLORATION

Motor activity directed towards the physical aspects of the environment, the dog is sniffing or licking/manipulating something or exploring the environment visually. Visual exploration; the dog is focusing on, and the muzzle is less than 10 centimeters away, from any physical aspect of the environment.

EXPLORATION PERSON

The dog is sniffing and/or licking on the stranger or familiar person.

E.F = exploration of the familiar person

E.S = exploration of the stranger

INDEPENDENT PLAY

Any motor activity directed towards the dog toy (or other object), including chewing, biting, shaking from side to side, holding a toy in its mouth, scratching or batting with the paw and tossing using its mouth, without any interactions with person.

SOCIAL PLAY (this behaviour can only occur if the play has been initiated by the stranger)

Any motor activity directed towards the toy, with physical contact, including chewing, biting, shaking from side to side, holding the toy in its mouth, scratching or batting with the paw, chasing toy in movement (thrown by the stranger) and tossing using its mouth, when interacting with the stranger. Interaction with stranger includes answering invitations to play from the stranger as following a toy the stranger is pulling from side to side on the floor (oriented to toy), chasing a toy that has been thrown, grabbing a toy while the stranger holds in the other end, tug and war play, locomotion with the toy in its mouth directed towards (muzzle directed) the stranger.

PLAY AT DISTANCE (this behaviour can only occur if the play has been initiated by the stranger)

Activity directed towards a toy including chewing, holding, shaking from side to side, chasing a rolling ball and/or battling with paws when out of reach for the stranger and/or not coming back with any thrown toy after 10 seconds and playing with it at distance from the stranger.

DRINKING

The dog is drinking from the water bowl.

NOT VISIBLE

The dog is not visible in any of the cameras

One-zero sampling

FOLLOWING

Locomotion in the same direction as a person who is also in locomotion.

F.F = following familiar person.

F.S = following stranger.

ORIENTED TO THE DOOR

The dog is sitting, standing or lying and focused on the door (enter/exit door), having the muzzle directed towards the door for > 2 seconds.

ORIENTED TO PERSON

The dog is sitting, standing or lying and focused on a person; having the muzzle directed towards a person for > 2 seconds.

O.F = oriented to familiar person.

O.S = oriented to stranger.

ORIENTED TO EMPTY CHAIR

The dog is sitting, standing or lying and focused on a persons empty chair, having the muzzle directed towards the empty chair for > 2 seconds.

O.F.C = oriented to the familiar persons empty chair.

O.S.C = oriented to the strangers empty chair.

CONTACT DOOR

The dog is scratching, jumping up against the door and/or physical contact with the door with the muzzle.

PHYSICAL CONTACT PERSON

Physical contact, initiated by the dog, with a person regardless of visual orientation, the dog is in physical contact with a person by pushing the muzzle against the person, scratching on the person with its paw, jumping up on person, jumping up in the knee of the person, leaning towards, sitting or lying with any body part in contact with a person.

C.F = physical contact with the familiar person.

C.S = physical contact with the stranger.

PHYSICAL CONTACT CHAIR

Physical contact with an empty chair regardless of the visual orientation, including sniffing on the chair, jumping up on it, sitting, standing or lying with any part of the body in contact with chair.

CFCH = physical contact with the familiar persons empty chair.

CSCH = physical contact with the strangers empty chair.

VOCALISATION

B = barking, short, intense sounds

G = growling, deep low frequency sounds from the dogs' throat

H = howling, longer, > 2 s, higher frequency sounds

W = whining, squeaky noises

ROOM 2

> 50 % of the dog's body is located in room number 2.

BODY SHAKING

The dog shakes any part or the whole body from side to side "quickly".

STRETCHING

The dog is extending/stretching one part/many parts of its body.

YAWNING

The dog opens its mouth widely and inhales.

TAIL WAGGING

Repetitive wagging the tail from side to side and/or body wagging.

PANTING

The dog is breathing heavily with its mouth open.

GROOMING

The dog is “cleaning” its own body surface by licking, nibbling, picking, rubbing, scratching (self-grooming).

Continuous sampling

LICKING LIPS

The dog is licking itself around the mouth area, tongue is visible. New observation every time the tongue is visible.