



Attachment style classification in the interspecific and intraspecific bond in dogs

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Abstract: There is scientific evidence that adult dogs establish attachment bonds towards their owners that share similar features with the child-mother bond. On the contrary, the nature of the bond between two adult dogs is still unclear. The aim of the study was to compare the interspecific and intraspecific attachment bond with a particular focus on the attachment style classification.

The Ainsworth Strange Situation Test was used to analyse the behavior of 14 dogs (8 females and 6 males) tested twice: once with the owner and once with a cohabitant dog, in a counterbalanced order. Frequency and duration of 22 behaviors were measured and compared using the Wilcoxon test ($p < 0.05$). Dogs were also classified as either securely or insecurely attached.

When tested with the conspecific, dogs spent more time in “vocalizations” ($p = 0.001$) and “proximity to door” ($p = 0.001$), while, on the contrary, they spent more time in “contact” ($p = 0.016$) during the interspecific procedure, suggesting a higher level of stress for dogs tested without their owners.

As for the attachment style towards the cohabitant dog, 57.1% of dogs were classified as securely and 42.8% as insecurely attached. No agreement was found in the classification of attachment style between the intraspecific and interspecific tests (Cohen’s $\kappa = -0.089$).

The results on attachment style classification suggest that, in dogs as in infant-caregiver dyads, the secure attachment is the most represented, both for the interspecific and intraspecific procedures, although in the latter the picture is less clear; In addition, dogs can show different styles towards different individuals. Nevertheless, further research is needed, especially for the intraspecific procedure.

Key Words: Ainsworth strange situation test; attachment bond; attachment style; dog; interspecific; intraspecific.

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Introduction

The attachment theory was developed by John Bowlby (Bowlby, 1988) in the 1950’s, thanks to the constructs provided by psychoanalysis and ethology (Harlow, 1958; Lorenz, 1961).

Attachment is defined as a particular kind of affectional bond that ties a subject (person or animal) to another specific individual, binding them together in space and enduring over time (Ainsworth & Bell, 1970). It is characterized by specific features: contact maintenance, which is maintaining contact and proximity with the attachment figure; searching response (or protest at separation) when involuntarily separated from the attachment figure; secure base effect which refers to the fact that the attachment figure represents a base from which to explore the world (Ainsworth, 1969; Ainsworth & Bell, 1970; Bowlby, 1988); safe heaven effect, i.e. the attachment figure provides a sense of safety in times of threat or distress (Kerns *et al.*, 2015).

The most used method to study attachment behavior is the Strange Situation Test elaborated by Ainsworth (ASST). This laboratory procedure was originally designed to examine the balance of attachment and exploratory behaviors under conditions of low and high stress. Because the ASST is based on the evolutionary purpose of attachment behavior, some authors have successfully adapted it for ethological studies (Miller *et al.*, 1986, 1990).

The first authors to study whether the bond between dogs and humans had to be considered an attachment bond, using a modified Strange Situation Test, were Topàl *et al.* (1998). Several

authors followed Topál's et al. work, investigating interspecific attachment between dogs and their owners (Payne et al., 2015; Rehn & Keeling, 2016).

Since the attachment theory is valid for all mammals, it seems plausible that two conspecifics, regardless of the species, may become attached to each other. However, so far the results do not fully support this hypothesis (Mariti *et al.*, 2014, 2017, 2018). A very recent study by Sipple *et al.* 2021 compared the attachment style of dogs towards the owner with that towards another dog, using a short behavioral test composed of 3 episodes. The results showed that the relationships that a dog forms with the owner is different from the one shared with a conspecific living in the same household. Specifically, owners (being the primary caregiver) are more likely to provide attachment security than a companion dog. In their study, dogs, maintained proximity with the human caregiver for a longer time than with the cohabitant dog. Furthermore, they kept searching for their owners even in the episode in which the cohabitant dog was present. These results support Mariti et al.'s suggestion that the higher stress level showed by dogs during intraspecific procedure is due to the absence of the owner during the whole test (Mariti *et al.*, 2018). In the current study, we further investigated possible differences or similarities between an interspecific and an intraspecific bond using the full version of the ASST.

The ASST as it is relies on quantitative investigation methods, that consequently, are less suitable to define pattern classification. For this reason, some authors developed a dog-adapted version of the attachment style classification used for human infants (Schöberl et al., 2016; Solomon et al., 2019). Recently a work by Riggio et al. (2021) proposed a classification that focuses on the general concepts that characterize each attachment pattern, with the aim of providing a tool able to minimize disagreement among observers and facilitate future repeatability. Referring to it, we tried to assess whether the description of the attachment styles provided by Riggio et al. (2021) for classifying the dog's bond towards the owner could be effectively used in the classification of dog's interspecific, as well as intraspecific attachment. In order to do so, we applied this classification to dogs tested with both the owner and the conspecific.

Materials and methods

Ethical considerations

The current study used videos previously recorded for a dog attachment research by Mariti et al. (2018). Since it was an observational study involving owned dogs, it did not require the approval from the ethical committee. However, before testing each dog, owners had to fill out informed consent and provide their authorization for being video recorded.

Participants

Fourteen dogs of both sexes (8 females and 6 males), of different ages (42.3 ± 22.3 months-old) and breeds were involved in this study as tested subjects. The subjects were selected according to the following inclusion criteria: being more than 14 months old, having lived with the other dog and the owner for at least 9 months, being used to a wide variety of environment (which meant places other than home) and people (which meant not being fearful nor aggressive to strangers, for safety reasons). Each dog, before being tested, underwent a veterinary consultation, in order to exclude the presence of behavioral disorders that could affect the results of the research (social and environmental phobias, aggressive behavior towards people or conspecifics, separation related problems) as well as to ascertain that all the subjects were healthy. Throughout the study the same veterinarian was in charge of conducting the consultations. None of the female dogs were in estrus, nor were they pregnant at or around the time of testing. Dogs' behavior was analysed in two modified version of the Ainsworth strange situation test. Each dog was tested twice, once for the intraspecific

test and once for the interspecific one. Half of the sample underwent intraspecific test first, while the other half underwent the interspecific test first, to reduce a possible order effect. The stranger was always played by a young woman unfamiliar to the dogs. This person was not always the same one, however, to reduce the risk of an effect of the individual, we decided that the stranger should always be played by different women. In the intraspecific test a second person helped the stranger for the entrance and the exit of the second dog. As in the case of the stranger, this person was always played by a different woman. In the intraspecific test, the presumed attachment figure was played by another dog living in the same household (an unrelated dog), whilst for the interspecific one, the presumed attachment figure was the owner (Mariti et al., 2018).

All owners were volunteers recruited through personal contacts. In case the dog lived in a multi-member family, the person participating was the one reported as the family member preferred by the dog. The two tests were separated at least 35 days one from the other.

Procedure and setting

Dogs were tested in a relatively bare room, unfamiliar to the subjects, at the Department of Veterinary Sciences - University of Pisa (Italy). The room (4.50 × 4.30 m) was arranged to follow, as closely as possible, the characteristics present in the original ASST (Ainsworth and Bell, 1970). The room was isolated, as much as possible, from outside noises, and was equipped with chairs (one for the stranger in the intraspecific test and two in the interspecific one, for both the stranger and the owner), a water bowl, a table to lay the leash on and a single door. No toys were present to avoid possible aggression between dogs. All the tests were recorded with two video cameras, one oriented to the area surrounding the door and the other to the whole room. Tests were conducted when the building was not in use.

The behavioral test used in this study was as faithful as possible to the ASST (Ainsworth & Bell, 1970). The full procedure is described in Mariti et al. (2014, 2017, 2018) and reported in the table below (Table 1).

Table 1. The seventh episodes of the Ainsworth Strange Situation Test, in both the intraspecific (on the left) and interspecific (on the right) procedure.

EPISODES	DESCRIPTION	
1	Dog 1 + Dog 2 free in the room	Dog 1 + Owner
	A strange person enters the room	
2	Dog 1 + Dog 2 + Stranger	Dog 1 + Owner + Stranger
	The stranger goes to the chair and can greet the dogs, then she has to ignore them	
	Dog 2 leaves the room	The Owner leaves the room
3	Dog 1 + Stranger	
	Dog 2 enters the room	The Owner enters the room
4	Dog 1 + Dog 2	Dog 1 + Owner
	Dog 2 leaves the room	The Owner leaves the room
5	DOG 1 ALONE In case the dog is too stressed for more than 60 s, the stranger can enter	
	A strange person enters the room	
6	Dog 1 + Stranger	
	The strange person leaves the room	
	Dog 2 enters the room	The owner enters the room
7	Dog 1 + Dog 2	Dog 1 + Owner

Attachment style classification

At the time this study was carried out, no literature on intraspecific attachment styles was available and only few papers on interspecific attachment were published (Schöberl et al., 2016;

Solomon et al., 2019; Riggio et al., 2021). In this study, the classification proposed by Riggio et al. (2021), in which greater prominence was given to patterns rather than to specific behaviors shown by dogs, was used for both the interspecific and intraspecific procedures. Since for the intraspecific test classifying dogs with a precise attachment style was not easy, it was agreed that in case of uncertainty, prominence was given to episode 7 (as in Riggio et al., 2021), as the activation of the attachment behavioral system should make the style more evident (Lamb, 1980). In addition, this was the first time that the classification of attachment style proposed by Riggio et al. (2021) was used in the intraspecific test.

Since there were a limited number of dogs in the current study the decision was made to classify them only as secure or insecure.

Two observers analysed the videos of the 14 dogs in both the interspecific and intraspecific tests.

Statistical analysis

Although for behaviors categorised as states three parameters were measured (number of occurrences, total duration and mean duration), for the current study only total durations were statistically analysed. For stress behaviors, being events, number of occurrences were analysed.

The distribution of data was checked using the Kolmogorov-Smirnov test ($p < 0.05$). As data resulted to be not normally distributed, not parametric statistical analyses for paired data were carried out. In particular, the Wilcoxon rank test ($p < 0.05$) was used to test the following comparisons:

- Non-social behaviors in episode 7
- Social behaviors towards the owner versus the cohabitant dog in episode 7

All statistical analyses were run with the software SPSS Statistic 17.0 (Chicago, IL).

Regarding attachment style classification, the agreement between both the procedures and observers was measured with Cohen's Kappa coefficient.

Kappa values were interpreted as follows (McHugh, 2012):

- ≤ 0 no agreement
- 0.01-0.20 none to slight agreement
- 0.21-0.40 fair agreement
- 0.41-0.60 moderate agreement
- 0.61-0.80 substantial agreement
- 0.81-1.00 almost perfect agreement.

Results

Behavioral observation

The ethogram used in the intraspecific test had to be adjusted to the impossibility of standardizing the cohabitant dog behavior, resulting in some slightly different variables than those used in the interspecific procedure. For instance, the "proximity to door" behavior used in the interspecific test was split into "proximity to door: alone" and "proximity to door: with cohabitant dog". As for the statistical analysis, proximity to door in the interspecific test was compared to both types of proximity to door behaviors reported in the intraspecific test, as well as to the sum of both. A significant difference was found between the duration of "proximity to door" (interspecific test) and "proximity to door: with cohabitant dog" (intraspecific test) ($p = 0.001$), as well as between the former and the sum of proximity to door behaviors (intraspecific test) ($p = 0.001$). Specifically, if we refer to the "proximity to door: with cohabitant dog" behavior alone, we found that dogs in the intraspecific test spent less time near the door. However, when considered the time spent close to the door regardless of the vicinity of the conspecific, they spent more time in proximity to the door than

did dogs in the interspecific test. Furthermore, during episode 7, i.e., when the presumed attachment figure was present, we observed that while for dogs tested with owners there was a tendency to decrease the amount of time spent in proximity to the door, dogs tested with conspecifics tended to increase it. Nevertheless, the aforementioned results were not statistically significant.

The difference in the duration of vocalizations (which refer to two different types of sound, namely “yelping/whining” and “barking”) between the two tests was significant ($p=0.001$). In fact, dogs tested with conspecifics vocalized significantly more in episode 7 than the ones tested with owners.

With regard to social behaviors, no significant difference was found between “proximity to owners” and “proximity to cohabitant dog”. On the contrary, when analysing contact behavior ($p=0.016$) a significant difference was found between interspecific and intraspecific test. In fact, dogs tended to ask more for physical contact when in presence of the owner rather than with a conspecific.

Attachment style classification

As for the Attachment style classification, the reliability between two researchers working independently on the sample of 14 dogs was measured. As a result, the two classifiers reached an agreement of 78.6% (11 out of 14 dogs) for the interspecific procedure, and an agreement of 71.4% (10 out of 14 dogs) for the intraspecific one.

In the interspecific procedure 78.6% (11 out of 14 dogs) of the dogs were classified as secure, while 21.4% (3 out of 14 dogs) were classified as insecure. Instead in the intraspecific test 57.1% (8 out of 14 dogs) of dogs were secure, while 42.9% (6 out of 14 dogs) were insecure. Cohen’s Kappa (agreement coefficient) was estimated between the two observers, respectively in the interspecific procedure $k=0.276$ and intraspecific one $k= 0.440$, as well as between tests $k= -0.089$ (tables 2, 3 and 4).

Table 2. Contingency table for Coehn’s Kappa. Agreement between interspecific and intraspecific’s attachment style classification (observation done by an expert observer). $K= -0.0089$ means that there was no agreement between the two tests.

		<i>Intraspecific</i>	
		<i>Secure</i>	<i>Insecure</i>
<i>Interspecific</i>	<i>Secure</i>	6	5
	<i>Insecure</i>	2	1

Table 3. Contingency table for Coehn’s Kappa. Agreement between the two observers in the interspecific test. $K= 0.276$ means that there is a modest agreement between observers.

<i>Interspecific procedure</i>		<i>Observer 2</i>	
		<i>Secure</i>	<i>Insecure</i>
<i>Observer 1</i>	<i>Secure</i>	10	1
	<i>Insecure</i>	2	1

Table 4. Contingency table for Cohen’s Kappa. Agreement between the two observers in the intraspecific test. $K= 0.440$ means that there is a moderate agreement between observers

<i>Intraspecific procedure</i>		<i>Observer 2</i>	
		<i>Secure</i>	<i>Insecure</i>
<i>Observer 1</i>	<i>Secure</i>	5	3
	<i>Insecure</i>	1	5

Discussion

The aim of the current study was to further investigate possible differences and similarities between attachment bond in human-dog dyads (interspecific attachment) and dog-dog relationship (intraspecific attachment). At the same time, the authors aimed to find out whether the description of the attachment styles provided by Riggio *et al.* (2021) could be effectively used in the classification of both interspecific and intraspecific attachment in dogs.

Concerning the behavioral analysis, results suggest that the presence of a cohabitant dog is not enough to calm down the tested individual upon reunion. In fact, during episode 7, dogs tended to vocalize more in the presence of the conspecific rather than when the owner returned, meaning that the presence of the presumed attachment figure (during intraspecific test) was not able to decrease their stress levels as much as the owner's presence. Similar results were also found in Sipple *et al.* (2021) where dogs tended to vocalize significantly more upon reunion with the conspecific compared with the return of the owner, as well as in Mariti *et al.* (2018) where dogs showed more stress, in the form of an increase in vocalizations, when the cohabitant dog was present. In addition, in the reunion episode, dogs tended to decrease their proximity to the door in case they reunited with their owners, whereas they increased it when tested with the conspecifics. A possible explanation could be that dogs in the intraspecific test are more stressed by the separation from the owner, which occurred before the procedure started, than by the absence of the cohabitant dog (Mariti *et al.*, 2014). Another explanation is that the tested dogs spent longer time in proximity to the door as an indirect effect of seeking proximity to the cohabitant dogs. In fact, while the protocol for the owners was standardized by asking them to sit on a chair far from the door, on the contrary, the behavior of the conspecifics could not be standardized and that means they were free to move in the experimental room.

On this regard, in a recent study by Riggio *et al.* (2022), authors investigated the behavior of both dogs during an intraspecific ASST. Results showed that both dogs tend to stay in proximity to the door for most of the time; however, it is not possible to generalize these results since there are various factors such as ASST episode, type of relationship between the two dogs, sex of the dyads, age difference, that affected behaviors during ASST.

No statistical difference between proximity to the owner and proximity to the cohabitant dog was revealed by the analysis on the behavioural patterns towards the presumed attachment figure. Again, this may be due to the fact that in the intraspecific test the presumed attachment figure's behavior could not be standardized. However, we did find significant results for contact behavior when comparing interspecific and intraspecific test. Specifically, we observed that dogs tended to search more for physical contact when in the presence of their owners rather than when in the presence of the cohabitant dog. This result seems to confirm the different nature of the relationship between dogs and their owners and the one between dogs and familiar conspecifics (Sipple *et al.*, 2021), being the latter less clear in terms of asymmetry of the secure base effect, and therefore less suitable to be described with the parent-child attachment construct. However, previous authors suggest that humans, like the majority of primates, tend to use tactile communication more frequently and for longer times than canids (Siniscalchi *et al.*, 2018), showing their affection through physical contact (Kuhne *et al.*, 2012). Furthermore, owners may reinforce their dog's contact seeking behaviors and physical interactions (Kostarczyk & Fonberg, 1982; McGreevy, *et al.*, 2005). In fact, as remarked by Savalli and Mariti (2020), physical contact is particularly important for the development of the attachment bond not just between human infants and their mothers, but also between owners and their dogs. For instance, previous studies show a reduction in behavioural and physiological indicators of stress (Hennessy *et al.*, 1998; Coppola 2006; Kuhne 2014; Mariti *et al.*, 2018), as well as an increase in salivary levels of oxytocin in both owners and dogs after a session of affiliative physical interaction (Nagasawa *et al.*, 2009; Handlin *et al.*, 2011, 2012).

Moreover, Riggio et al. (2021) found that dogs with a secure attachment style showed an increase in proximity and contact seeking behaviors toward their owners compared to insecurely attached dogs, confirming the importance of physical contact in both the formation and the evaluation of the dog's attachment pattern towards the owner.

With regard to the attachment style classification, previous studies (Solomon *et al.*, 2019; Riggio *et al.*, 2021; Thielke *et al.*, 2017; Wanser & Udell, 2019) agree with the secure attachment style to be the most represented in their experimental samples. In the current study results for the interspecific test are similar to those reported in Riggio *et al.* (2021). More in detail, 78.6% of the dogs in the interspecific test were classified as securely attached to their owners compared to the 80% reached in Riggio *et al.* (2021).

To the best of our knowledge, Sipple *et al.* (2021) are the only researchers that attempted to classify dog's attachment style towards both the owner and a cohabitant conspecific, by using the descriptions provided by Thielke *et al.* (2017) for the assessment of dog interspecific attachment. According to their classification, 95% of the dogs were labelled as "unclassifiable", when tested with conspecifics. A possible explanation is that those dynamics of interactions traditionally used to describe different dog attachment patterns towards humans are possibly not appropriate to assess interactions between adult dogs (Mariti *et al.*, 2017; Sipple *et al.*, 2021). In the current study, the number of securely attached dogs was lower in the intraspecific test, however more of 50% of the dogs were still classified as securely attached (57.1%), and none of them remained "unclassifiable". Dissimilarities between this and Sipple *et al.*'s study may be due to the difference in the protocols used; in fact, while we applied the full version of the ASST (7 episodes), Sipple *et al.* (2021) administered a shortened version with only 3 episodes, which might have led to a reduced activation of the attachment system (Riggio *et al.*, 2021). Not less importantly, we classified our dogs' attachment style based on the description provided by Riggio *et al.* (2021) rather than Thielke *et al.*'s (2017).

The mismatch between attachment styles in the interspecific and intraspecific test (Cohen's $k = -0.089$) suggests that in dogs, as in humans, the style of attachment can differ according to the individual it is directed to, regardless of the species, with the same dog being attached in a different manner to both heterospecifics and conspecifics (Sipple *et al.*, 2021). As previously mentioned, it may as well be possible that the bond between two adult dogs is characterized by relational dynamics that cannot be interpreted within the parent-child attachment construct (Mariti *et al.*, 2013; Riggio, 2020; Savalli and Mariti, 2020). However, we must point out that, in the current study, the dog who played the attachment figure during the intraspecific test was never the experimental subject's mother. This possibly means that these dogs played a marginal role in the physical, cognitive and emotional development of the tested dog if compared to the role played by the owner, or even to the role that the actual mother might have had. For this reason, owners may more easily provide their dogs with a sense of security in stressful situations compared to an unrelated cohabitant dog. Interestingly, Sipple *et al.* (2021) suggest that dog's intraspecific attachment may be more similar to the relationship between two siblings that use different interactional systems than the ones in place between children and mothers, maintaining, nonetheless, a secure base effect (Stewart, 1983). Therefore, further research is needed to understand if the attachment style classification used for dog-to-owner attachment may be used in the assessment of intraspecific bonds, or given the possible different nature of such relationships, a distinct assessment tool is required.

Finally, it must be pointed out that, in this study, the agreement between the two observers was quite low in both tests (interspecific $k = 0.276$; intraspecific $K = 0.440$) since one of the observers did not receive any training before the observation done for the attachment style classification. In fact, in another study by the same research team the classification was done by two expert observers that obtained a substantial agreement with $k = 0.63$ (Riggio *et al.*, 2021). This suggests that a period of training is probably needed to better classify attachment styles in dogs, as it is in child-caregiver attachment studies. Another explanation is that Cohen's Kappa might be inadequate to value

agreement in specific situations, especially when there is an imbalanced distribution of classes, like in the current case (Delgado & Tibau, 2019).

This study has some limitations. First of all, the size of the sample, being relatively small, does not allow to generalize the results as the sample may be not representative of the entire dog population. Besides, due to the little number of subjects we were not allowed to perform any comparison between secure and insecure attachment style within the intraspecific test. Future research should involve a greater number of subjects to better investigate distribution of attachment style and their differences. In addition, as described in the methods, subjects had been selected through veterinary consultation, to exclude dogs with behavioral disorders or aggressive attitude. This practice might have altered the proportion of different attachment styles leading to a greater number of securely attached subjects.

Conclusions

This is the first study to use the description provided by Riggio et al. (2021) for the assessment of attachment styles in both an intraspecific and an interspecific ASST. Results suggest that, like in human infants, secure attachment is the most represented style for dogs tested in both the interspecific and the intraspecific procedures. Furthermore, the longer time spent seeking contact with the owner suggests that adult cohabitant dogs may not provide younger conspecifics with the same sense of security that is, instead, offered by the owner. This result points towards a different nature of the dog-dog bond, which may not be successfully explained by the same child-mother attachment construct that, on the contrary, fits well with many aspects of the dog-owner relationship. To conclude, further research is needed to better understand the nature of intraspecific attachment, its features and what kind of assessment tool may be more suitable to confirm the presence and possibly investigate the quality of the attachment bond between dogs.

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Classificazione dello stile di attaccamento nel legame di attaccamento inter ed intraspecifico nel cane

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Sintesi

Esistono prove scientifiche che cani adulti stabiliscano legami di attaccamento verso gli esseri umani. La letteratura precedente riguardante il legame tra due cani adulti mostra meno somiglianze con il legame tra caregiver-bambino.

Lo scopo dello studio è stato quello di confrontare il legame di attaccamento interspecifico e intraspecifico con un focus particolare sulla classificazione dello stile di attaccamento.

Una versione modificata dell'Ainsworth Strange Situation Test (ASST) è stata utilizzata per analizzare il comportamento di 14 cani (8 femmine e 6 maschi). Ogni cane è stato testato due volte: una con il suo padrone e una con un cane convivente, in ordine controbilanciato. La frequenza e la durata di 22 comportamenti sono state misurate in entrambe le condizioni e confrontate utilizzando il test di Wilcoxon ($p < 0,05$). Inoltre, i cani sono stati classificati come sicuri o insicuri.

Quando testati con il conspecifico, i cani trascorrevano più tempo in 'vocalizzazione' ($p=0,001$) e 'vicinanza alla porta' ($p=0,001$), mentre, al contrario, passavano più tempo in 'contatto' ($p=0,016$) durante la procedura interspecifica, suggerendo un livello di stress più elevato per i cani testati senza i loro proprietari.

Per quanto riguarda lo stile di attaccamento nei confronti del cane convivente, il 57,1% dei cani è stato classificato come attaccato in modo sicuro e il 42,8% come attaccato in modo insicuro. Non è stato trovato alcun accordo nella classificazione dello stile di attaccamento tra i test intraspecifico e interspecifico (Kappa di Cohen=-0,089).

I risultati sulla classificazione dello stile di attaccamento suggeriscono che, nei cani come nelle diadi bambini-caregiver, l'attaccamento sicuro è il più rappresentato, sia per la procedura interspecifica che intraspecifica, e che i cani possono mostrare differenti stili di attaccamento nei confronti di individui diversi. Tuttavia, sono necessarie ulteriori ricerche, soprattutto per la procedura intraspecifica.