



# Attachment: a new approach to predict the success of future guide dogs? a pilot study

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## Abstract

Guide dogs are a major resource for people with visual impairment. Unfortunately, more than one-third of them are reformed each year because they do not have the required qualities. Their specific training leads them to establish several interspecific attachment bonds, the first one with their puppy raisers, which constitutes an important emotional base for their future cognitive-emotional development and mental stability. Eight guide dogs aged between 1 and 2 years in the training period and their puppy raisers were involved. This is a preliminary study that aimed to investigate attachment behaviours in guide dogs towards their puppy raisers using the Strange Situation Test (SST). The second goal was to assess the suitability of using psychometric scales measuring the emotional state of the animals in this shared-custody context. Two psychometric scales that reflect dogs' impulsivity and sensitivity levels were applied through questionnaires-the Dog Impulsivity Assessment Scale (DIAS) and the Positive and Negative Assessment Scale (PANAS)-completed by the puppy raisers and principal trainers. The SST revealed a preference among the dogs for their puppy raisers over a stranger, as evidenced by expressing more secure base effect behaviour when the puppy raiser was present (Tukey-Kr; DF=13.9; t=3.05; p=0.02) and greater proximity seeking behaviour towards the puppy raiser than towards the stranger (Student's t-test; DF=1; t=2.66; p=0.03). The test also highlighted a strong difficulty in remaining alone, as demonstrated by a longer duration of door proximity behaviour when alone (Tukey-Kr; DF=7; t=5.15; p<0.001). Notably, the results of the questionnaire score analysis revealed a discordance between the perception of educators and puppy raisers, giving uncorrelated scores. This study will be repeated once the dogs have been adopted by visually impaired children to assess the continuity of the attachment bond developed with the foster family over time and determine whether this bond influences the success of the dogs and their ability to create a new bond in the long term.

**Keywords:** Ainsworth Strange Situation Test; Attachment; Emotional state; Foster family; Human dog relationship

## Introduction

Guide dogs accompany people with visual impairments to increase their independence by providing them assistance in their daily tasks [1]. The relationship is based on mutual trust, which is essential for the proper functioning of the dyad [2]. Indeed, the dog must be able to deal with all sorts of unforeseen circumstances that might be encountered in the course of its work. Not reacting when faced with a sudden event, organizing the environment, and showing the way when encountering an obstacle are all indispensable skills that help ensure the safety of the person and the fluidity of his/her movement [3]. Emotional balance and the capacity to cope with emotional distress are therefore the most desired characteristics in guide dogs [4]. These characteristics could play a fundamental role in both the acquisition of relevant skills and in the dog's ability to put

these skills into practice every day with the person it accompanies. Unfortunately, a large proportion of dogs are excluded from the guide dog programme [5-7]. In 2016, the percentage of reformed or reoriented dogs was estimated at approximately 40% in France [8], of which 60% occurred for behavioural reasons [9]. Dogs are usually trained by a federated association, foundation or training programme. Early detection of problems or difficulties is therefore desirable to avoid as much financial and time loss as possible due to the high cost of each animal for diet, health care and training, which usually amounts to between 20,000 and 25,000 euros per dog in France [10].

As a result of training, guide dogs establish different emotional bonds with different people during the first two years of life:

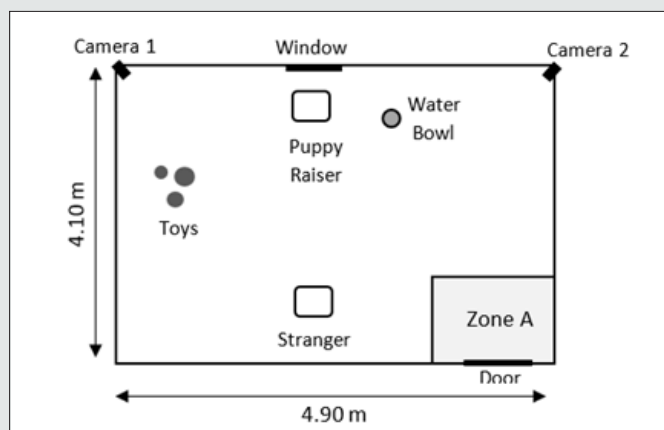
the dog's mother and siblings initially, then the foster family, the educator, and finally the visually impaired person the dog will accompany. Foster families keep dogs from the weaning stage and teach them basic rules in terms of education. They are therefore considered very important in the breeding of future guide dogs [11]. Attachment, as developed, is described as the product of behaviours aimed at seeking and maintaining proximity to a specific person. This is an important concept defended by several authors, including [12-15], who claim that the theory is valid for all mammals. According a secure base effect is the main factor indicating the presence of an attachment bond between two individuals. Accordingly, they constructed the strange situation test (SST - fully described by the authors, 1970) to measure the relationship between a child approximately one year old and his or her significant person, most often the mother. Since then, several researchers have shown that attachment can also exist interspecifically between a dog and its handler, thanks to a revised version of this test, the SST-R [16-20]. The presence of this bond was confirmed by the work and who stipulated that people can act as a secure base for their dogs. This paper is a preliminary study of the largest research area. The goal is to understand the bond developed

by the future guide dogs towards their puppy raisers and to assess the appropriateness of using scales measuring the emotional state of the animals through its levels of sensitivity and impulsivity in this particular context, in which several people share phases of dog development. The study was conducted in collaboration with the Frederic Gaillanne Foundation (L'Isle-sur-la-Sorgue, France), which is the first school in Europe to train guide dogs only for children with visual impairment and assistance dogs for children with developmental disabilities.

## Materials and Methods

### Subjects

Eight dogs, including 5 females and 3 males St. Pierre dogs from the Frederic Gaillanne Foundation participated in the study with their puppy raiser. They were all neutered and had a mean age of 24 months ( $\pm 6$  months). To be included in this study, they had to live with their foster family for at least 3 months and not have experienced any major change in their routine before the test. They all started their guide dog training 7 months ago. They are at the foundation from Monday to Friday, then they go back to their host families on weekends.



**Figure 1:** The experimental room was equipped with two chairs, three dog toys, a water bowl and two video cameras. Zone A (1.40 m x 1.30 m) = Door Proximity Area.

### Experimental design

The experimental environment was as close as possible to the standards used in the SST-R [21,22]. The room (4.9 m x 4.1 m), which was located at the Clinical Ethology and Animal Welfare Centre (CECBA) of the Research Institute in Semiochemistry and Applied Ethology (IRSEA), was unfamiliar to the dogs. The room was equipped with 2 chairs, 3 toys, 1 water bowl and 2 cameras (Figure 1). All tests were performed in the late morning between 10 a.m. and 11 a.m., and only 1 test was performed per day to avoid any possible olfactory influence.

### Procedure

The puppy raiser participating in the experiment had previously received and completed two questionnaires-the Positive

and Negative Assessment Scale for dogs (PANAS) [23] and the Dog Impulsivity Assessment Scale (DIAS) [24]-via Google Forms; these scales measure the levels of sensitivity and impulsivity of dogs, respectively. The PANAS consists of 21 items, and the DIAS consists of 18 items. Both questionnaires use a 5-point Likert scale, ranging from "strongly disagree" to "strongly agree". A "don't know/not applicable" option was also possible. The lead educator for each dog was also asked to complete the PANAS and DIAS. The experiment was based on the modified version of the Ainsworth SST adapted to dogs [15,17] and was video recorded. The experimental phase was divided into the episodes described in Table 1. The same woman played the role of the stranger in all scenarios as described in the literature [7,12,16]. All participants signed an authorization to acquire, reproduce and broadcast images.

**Table 1:** Description of the strange situation procedure (Fallani et al., 2007).

Episode (3 minutes each)	Description
1: PR* and dog	The PR sat quietly, interacting with the dog only if it was looking for attention. The dog was free to explore the room.
2: PR, dog and S*	The stranger entered the room, sat quietly for 1 min, conversed with the PR for the second minute, approached the dog and attempted to stimulate play during the last minute. At the end of this episode, the PR left the room unobtrusively.
3: S and dog (1 <sup>st</sup> separation episode)	The stranger continued to play with the dog if it was willing; if it was inactive or distressed, the stranger attempted to distract it with play or by providing verbal and tactile comfort.
4: PR and dog (1 <sup>st</sup> reunion episode)	The PR entered the room and greeted and/or comforted the dog as usual. The stranger quietly exited the room. The PR had been told that he/she was free to play with the dog throughout the episode. At the end of this episode, the PR left the room.
5: Dog alone (2 <sup>nd</sup> separation episode)	The dog remained alone for 3 min but was constantly observed by the PR and researchers on the monitor in the adjacent room.
6: S and dog	The stranger entered the room and followed the same protocol as in episode 3.
7: PR and dog (2 <sup>nd</sup> reunion episode)	The PR entered the room and greeted the dog as usual. The stranger left the room unobtrusively. At the end of this episode, the experimenter arrived and officially terminated the procedure.

### Data collection

All tests were filmed and analysed twice by the same person at 6-month intervals to evaluate intraobserver reliability. Behavioural Observation Research Interactive Software (BORIS) [10] was used with the 5-second interval scan sampling method for the 7 episodes. Based on previous studies [4,12,13], the behaviours described in Table 2 were noted and organized into categories. These behaviours

were mutually exclusive, except for “physical contact” and “greeting behaviour”, which could be associated with each other. The duration of “greeting behaviour” and “door proximity” was also collected. The sensitivity (PANAS) and impulsivity (DIAS) questionnaires were scored according to the method described by the authors [20,24], yielding scores between 0 and 1. The two scales comprise different factors and the following scores:

**Table 2:** Behavioural categories recorded in the Strange Situation Test.

Behaviour category	Definition
<b>Secure Base Effect</b>	
Individual play	Any vigorous or galloping gaited behaviour directed towards a toy when clearly not interacting with any participants, including chewing, biting, shaking from side to side, scratching or batting with the paw, chasing rolling balls and tossing using the mouth.
Social play	Any vigorous or galloping gaited behaviour performed when interacting with the PR* or the stranger, including running, jumping, active physical contact, and chasing toys.
Exploration	Activity directed towards physical aspects of the environment, including sniffing, close visual inspection, distal visual inspection, and gentle oral examination such as licking.
Passive behaviour	Sitting, standing or lying down without any obvious orientation towards the physical or social environment.
Physical contact	Being in physical contact with the PR or the stranger.
<b>Proximity Seeking</b>	
Following	Following the person around the room or to the door.
Approach	Approaching while clearly visually oriented to the person.
Oriented to a person	Staring fixedly at the PR or the stranger regardless of whether the behaviour was reciprocated.
<b>Search Behaviour</b>	
Scratching the door	All active behaviour resulting in physical contact with the door, including scratching the door with the paws, jumping on the door, and pulling on the door handle with the forelegs or mouth.
Oriented to the chair	Staring fixedly at the PR's or stranger's empty chair.
Oriented to the door	Staring fixedly at the door either when close to it or from a distance.
Greeting behaviour duration (sec.)	All greeting behaviours towards the entering PR or stranger, such as approaching, tail-wagging, jumping, and physical contact.
Door proximity duration (sec.)	Time spent in the area near the door (zone A, Fig. 1).
Other behaviour	All behaviour not included in this catalogue.

\*PR = Puppy Raiser

1. The DIAS includes 4 scores: "behavioural regulation", "aggression/response to novelty", "responsiveness" and "overall score".
2. The PANAS includes 5 scores: "negative activation" and "positive activation", itself composed of "energy and interest", "persistence" and "excitement" scores.

### Statistical analysis

The analyses were carried out using SAS 9.4 software Copyright (c) 2002-2012 by SAS Institute Inc., Cary, NC, USA. The significance threshold was classically fixed at 5%.

### Evaluation of attachment

Intraobserver reliability between the 2 observations separated by a 6-month interval was assessed for each parameter ("secure base effect", "comfort seeking", "proximity seeking", "search behaviour", "greeting behaviour" and "door proximity"). Pearson correlation coefficients were calculated if the hypothesis of normality of the parameters being compared was verified; otherwise, Spearman correlation coefficients were calculated. The behaviours "physical contact", "proximity seeking", and "greeting behaviour" were analysed using a 2 x 2 comparison between the puppy raiser and the stranger. For this purpose, after checking the normality conditions, Student's t-test for matched samples was carried out using the t-test procedure. The behaviours "secure base effect" and "search behaviour" were compared between episodes 2 and 4 and episodes 3 and 6, respectively. The "door proximity" behaviour was

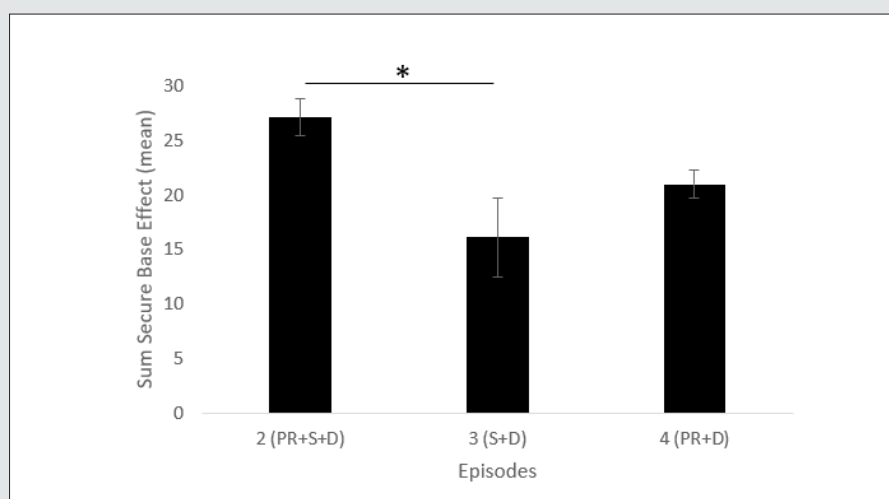
analysed under 3 conditions: when the dog was alone (episode 5), when the dog was in the presence of the puppy raiser (the average of episodes 2, 4, and 7), and when the dog was in the presence of only the stranger (the average of episodes 3 and 6). To do this, the assumption of normality was tested using the residual diagnostics plots and the UNIVARIATE procedure. Comparisons between conditions were performed with a general linear model (GLM) using the MIXED procedure to consider repeated measurements. The best variance-covariance matrix was selected by minimizing the AICC and BIC of the model. When a significant difference was observed, multiple comparisons were made using the Tukey-Kramer test using the LSMEANS statement.

### Evaluation of psychometric scales

Regarding the DIAS and PANAS questionnaires, 2 x 2 correlations were made between the responses of the puppy raisers and educators for the overall scores and each of the factors. For this purpose, when normality was verified using the UNIVARIATE procedure on SAS software, the Pearson correlation coefficient was calculated using the CORR procedure. Normality was not verified for the "aggression/response to novelty" factors or the overall DIAS score, and the Spearman correlation coefficient using the CORR procedure was preferred. According to Martin and Bateson (2007),  $r = 0.4-0.7$  indicates a moderate correlation (substantial relationship),  $r = 0.7-0.9$  indicates a high correlation (marked relationship) and  $r = 0.9-1.0$  indicates a very high correlation (very dependable relationship). Finally, the association was evaluated by computing the square of the correlation coefficient.

## Results

### Strange Situation Test



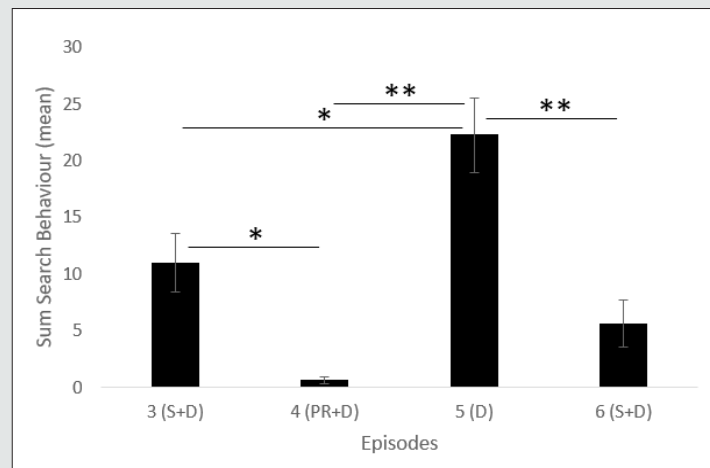
**Figure 2:** Episode effect on secure base effect. The mean  $\pm$  standard error. S = Stranger; PR = Puppy Raiser; D = Dog. \* $p < 0.05$ .

The statistical analysis of intraobserver reliability revealed a strong association ( $\geq 80\%$ ) between the observations for each parameter, with a minimum correlation of 0.89 (significance test;  $p < 0.001$ ). The results obtained for the "secure base effect"

highlighted significant differences between episodes (GLMM;  $DF=2$ ;  $F=4.66$ ;  $p=0.03$ ), with behaviours expressed more often when the puppy raiser was present with the stranger than when the dog was alone with the stranger (Tukey-Kr;  $DF=13.9$ ;  $t=3.05$ ;

$p=0.02$ ) (Figure 2). "Proximity seeking" behaviours were also more common in the presence of the puppy raiser than in the presence of the stranger (Student's  $t$ -test;  $DF=1$ ;  $t=2.66$ ;  $p=0.03$ ). To support these results, significant differences were found between episodes for "search behaviour" (GLMM;  $DF=3$ ;  $F=11.00$ ;  $p=0.01$ ) and "door proximity" (GLMM;  $DF=2$ ;  $F=11.98$ ;  $p<0.001$ ). These behaviours were significantly less common in the presence of the puppy raiser

and when the dog was in the presence of the stranger than when the dog was alone see Figure 3. Contrary to findings reported in the literature [15], data obtained for "greeting behaviour" were not significantly different across episodes (Student's  $t$ -test;  $DF=1$ ;  $t=0.61$ ;  $p=0.56$ ), and a tendency was found for "physical contact" towards the stranger (Student's  $t$ -test;  $DF=1$ ;  $t=-2.14$ ;  $p=0.07$ ).



**Figure 3:** Episode effect on search behaviour. The mean  $\pm$  standard error. S = Stranger; PR = Puppy Raiser; D = dog. \* $p < 0.05$ ; \*\* $p < 0.01$ .

### Psychometric scales

On the psychometric scales, no significant positive correlation was found between the responses of puppy raisers and educators.

However, moderate negative correlations were detected for the reactivity score ( $r = -0.69$ ;  $p = 0.06$ ) and aggressiveness/response to novelty (Tables 3,4).

**Table 3:** Table of descriptive data and correlations between the results of the scores on the DIAS completed by the puppy raisers (PR) and the educators (ED).

	Mean $\pm$ Std error		Median		Min-Max		Correlation coefficient
	PR	ED	PR	ED	PR	ED	
Behavioural regulation	0.36 $\pm$ 0.02	0.46 $\pm$ 0.06	0.36	0.41	0.26-0.46	0.28-0.84	0.06
Aggression/response to novelty	0.31 $\pm$ 0.03	0.39 $\pm$ 0.03	0.28	0.40	0.24-0.44	0.24-0.48	<b>-0.44</b>
Responsiveness	0.73 $\pm$ 0.04	0.62 $\pm$ 0.03	0.74	0.60	0.56-0.88	0.50-0.80	<b>-0.69</b>
Overall questionnaire score	0.49 $\pm$ 0.02	0.52 $\pm$ 0.04	0.48	0.49	0.38-0.58	0.41-0.80	0.36

**Table 4:** Table of descriptive data and correlations between the results of the scores on the PANAS completed by the puppy raisers (PR) and the educators (ED).

	Mean $\pm$ Std error		Median		Min-Max		Correlation coefficient
	PR	ED	PR	ED	PR	ED	
<b>Negative activation</b>	0.34 $\pm$ 0.03	0.53 $\pm$ 0.05	0.32	0.53	0.24-0.48	0.36-0.76	-0.21
<b>Positive activation</b>	0.59 $\pm$ 0.04	0.53 $\pm$ 0.07	0.56	0.49	0.42-0.74	0.33-0.85	-0.03
Energy and interest	0.82 $\pm$ 0.06	0.60 $\pm$ 0.06	0.88	0.58	0.53-0.95	0.30-0.90	0.14
Persistence	0.39 $\pm$ 0.03	0.43 $\pm$ 0.10	0.40	0.33	0.25-0.50	0.20-0.90	0.05
Excitement	0.55 $\pm$ 0.08	0.53 $\pm$ 0.11	0.55	0.55	0.30-0.90	0.10-1.00	0.17



## Discussion and Conclusion

The objectives of this preliminary study were to investigate attachment behaviours in guide dogs and determine whether the impulsivity and sensitivity scales could be reliable indicators of the emotional state of these animals in this context of shared-custody dogs. The attachment relationships between dogs and their puppy raisers were assessed using the modified version of the Ainsworth SST-R. In this study, no inappropriate or pathological attachment was observed in the dogs, who expressed a preference for their puppy raisers. Regarding the psychometric scales, both the educators and the foster family were asked to complete the questionnaires to compare scores, but unexpectedly, no correlation was found, asking about the most reliable person to answer these questionnaires.

In the results obtained for the attachment test, comparisons of "secure base effect" behaviours according to episode revealed a higher occurrence of these behaviours in episode 2 (stranger and puppy raiser) than in episode 3 (stranger). This indicates that in the presence of an unknown person, puppy raisers facilitate their puppies' coping strategies, defined in psychology as a set of cognitive and behavioural efforts that individuals deploy in response to environmental variations they assess to be threatening. The presence of their attachment figure allows dogs to focus on the environment and interact with it more serenely. No significant differences in the "secure base effect" were found between episodes in which the dog was alone with the stranger (episode 3) and when it was alone with its puppy raiser (episode 4), unlike the results found and for both pet and working dogs (search and rescue dogs). In the present study, the presence of a stranger without established attachment with the dog did not prevent the dog from interacting confidently with the environment. Due to their training background, these dogs are subject to strong socialization and to high human contact from an early age and are not alone more than 4 hours per day. Subjects in the study [2] had a less disturbed routine, spending a good part of their days with only their owner(s) or alone at home, which could explain this discrepancy in results. Episodes 2 (stranger and puppy raiser) and 4 (puppy raiser) were also similar, as expected. Indeed, as long as the puppy raiser was present, the company of a stranger did not have a significant impact on the behaviours, indicating a secure base effect.

Despite a similar secure base effect in episodes 3 and 4, the dogs exhibited more searching behaviours, including "door orientation", when the puppy raiser was not in the room (episode 3). And he has shown that with secure attachment, searching behaviours are more common in the absence of the owner. In this study, a preference for the puppy raiser should be noted, and the preference may result in a functional attachment. These behaviours also occurred more often when the subjects were alone in the room than when in the presence of only the stranger. This observation may show that a person, even if unknown, is able to reduce the expression of certain behaviours expected during a separation from the owner. Some difficulty in remaining alone may be expected if attachment is too strong, as mentioned above. The conclusions are similar for time

spent near the door; human presence was preferred over being alone, resulting in a large amount of time spent in the area near the door when the dog was alone.

In accordance with what is found in the literature [7,14], more "proximity seeking" behaviour was exhibited towards the puppy raiser than towards the stranger during the test. These behaviours are representative of a visual search, looking for someone. This could represent the previously mentioned coping strategy, facilitating the return to exploration or other interactions with the environment (a secure base effect) after searching for the attachment figure. Physical contact, which is associated with an attachment bond [15,22], was not significantly higher for the puppy raiser and even showed a reverse trend during the test. In the absence of their puppy raiser, the dogs tended to interact with the unknown person through physical contact while performing searching behaviours (orientation towards the door, proximity to the door) simultaneously. The dogs moved between the door and the person, so physical contact could be interpreted here as a sign of seeking comfort and therefore be emotionally palliative, as previously discussed and is on one of their study. Finally, the times spent greeting the puppy raiser and the stranger when they entered the room were also comparable, contrary to expectations and the results, which showed that dogs generally spend more time greeting and in physical contact with their owners. The training received by these dogs and breed selection (St. Pierre) aim to foster close relationships between these animals and humans and to encourage the dogs to spontaneously seek contact, even with unknown people, which could justify these results.

One of the most important steps in the breeding of a guide dog is the period during which it lives with its foster family [15], which is why this study focused on the relationship that dogs can establish with their primary raisers. The foster family represents a particular situation in which the puppy raiser is not the real owner of the animal. Foster families, unlike dogs, are warned of the temporary nature of the relationship and tend to develop an avoidant type of attachment as a form of resistance in contrast to the animal, which develops attachment as any other puppy would with its new family. Accordingly, the first bonds of attachment that the animal establishes with humans-the puppy raiser in this case-may impact the mental balance of the dog and the implementation of coping strategies adapted to its work as a guide dog, allowing it to effectively manage daily challenges and respond adequately to unforeseen circumstances. Thus, the foster family is considered a very important element in the breeding of future guide dogs [12]. In this pilot study, the attachment between the dogs and their puppy raiser seemed balanced and functional, as the dogs recognized their puppy raiser as the person caring for them (feeding them, playing, etc.). The dogs also seemed to manage the strange episodes in the presence of an unknown person.

These dogs, generally benefiting from good socialization, would have greater interest in foreign persons than do pets, which agrees with the results of previous studies [5,16]. Desire for human contact makes it easier for these dogs to compensate and bridge the gap with

another human when their puppy raiser is absent. They frequently experience separations from their puppy raiser (training period with the educator at school) and interact with different people. It is important to note that these changing environments may raise questions about their well-being and the consequences it may have on the quality of their work. Several works [18,17] have shown that good welfare is linked to abilities and training performance in guide dogs. For this reason, it would be interesting to assess, in a future study, the impact of these multiple separations on the welfare of the dogs and thus on their ability to perform as guide dogs.

Puppy raisers and educators also completed psychometric scales to assess levels of impulsivity (DIAS) and sensibility (PANAS). A good emotional balance is fundamental to obtaining a good guide dog [11]. The aim here was therefore to determine whether these scales could be relevant tools and good indicators of the emotional state and so of the success of these dogs. No statistical positive correlation was found between the scores given by the educators and the puppy raisers in this context. In particular, "reactivity" and "aggressiveness/response to novelty" showed a moderate negative correlation. The reactivity score was higher in the answers of foster families answer, and the aggressiveness score was in those of the trainer. Several factors could explain these results. Indeed, even if the dogs live with the foster families, dog trainers are more experienced in evaluating dogs and could tend to be more demanding towards them because certain behavioural traits must be exhibited before a deadline in order for a dog to receive its certification. Another reason could be that the dogs act differently depending on their environment. They could learn that the foster family's home is a more permissive environment than the guide dog school. The limits given by the educator may be more specific, clearer and more comprehensible than those given by foster families. Finally, dogs are not exposed to the same stimulations in the same way. In fact, dog trainers are used to anticipating dogs' reactions to external stimulation, which may reduce the reactivity of the dog, but puppy raisers have less experience in this domain.

In this context, it is difficult to use these psychometric scales on guide dogs in an ongoing training program. It would be interesting to use a larger sample to determine whether there is a relationship between the results of these scales (from puppy raisers or dog trainers) and a dog's success, and whether the type of relationship established with the puppy raiser enables a lasting and complementary guide dog/child dyad. These results could be useful for identifying dogs with undesirable behaviours as soon as possible, to exclude them from the training program to avoid financial losses, or to focus the education on problematic behaviours.

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**Conflicts of Interest:** The authors declare no conflicts of interest.

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## Ethics Approval Statement:

This project was approved by the Research Institute in Semiochemistry and Applied Ethology (IRSEA) Ethics Committee (approval number CE\_2020\_01\_ADOB01).

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