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# Behavioral modification in sheltered dogs

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*Abstract*: The aim of this study was to assess whether one month's stay in a shelter causes any behavioral change in the guest dogs. Fifteen cross-breed dogs were video-recorded for twenty minutes in their boxes once a week for five times, starting from the third day after admittance to the shelter. A significant reduction was observed in the frequency of dozing (r=0.95; p=0.01), waving high tail (r=0.95; p=0.01), and waving tail (r=0.92; p=0.02); duration was reduced for lying down (r=0.93; p=0.021), dozing (r=0.98; p=0.003), and waving high tail (r=0.93; p=0.019). Moreover a significant increase was observed in the duration of activity behavioral patterns, such as scratching door (r=0.93; p=0.023) and digging (r=0.86; p=0.060). In addition, an increase was observed in the frequency of standing upright (r=0.92; p=0.026), scratching door (r=0.99; p=0.001), digging (r=0.91; p=0.034), whining (r=0.92; p=0.024), and scratching (r=0.93; p=0.024).

On the third and fourth week of their stay, some behaviors that are typical of a state of restlessness appeared, while others that are typical of a state of inactivity disappeared.

The dogs underwent a behavioral test involving the introduction of different stimuli (unexpected noise, food and toy) in an unknown place, which showed they had got used to such external stimuli as noise (p=0.004).

Data suggest that staying in a shelter can induce behavioral changes that should be carefully monitored to prevent behavioral problems which might develop after adoption.

*Key Words*: animal welfare, behavior, dog, shelter, stress.

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## Introduction

The arrival to the shelter may be considered a particularly stressful event for the dog, since the dog often comes there after a traumatic event such as abandonment and/or separation from its former family, maybe after having wandered about without food in an unknown environment, surrounded by unusual stimuli, before being captured. Therefore, the dog is brought into in an environment which, although meeting the rules set forth by all the national and local legislations, can be a source of stress, because of its new environmental conditions and because it deeply changes the dog's relationships with human beings (Coppola et al. 2006).

Stress can mainly modify dog behavior (Mariti et al., 2012), so it can be considered a reliable indicator (Beerda et al., 1998). Besides the above-mentioned factors, general environmental conditions, characteristics of the shelter and type of management are other possible sources of stress (Wells et al., 2002). As dogs are extremely social animals, housing them alone is generally considered to be negative for canine welfare (Hughes et al., 1989; Hetts et al., 1992; Hubrecht et al., 1992; Hubrecht, 1995; Mertens & Unshelm, 1996; Weels & Hepper, 1998). Factors including separation from the owner, handling by unfamiliar shelter staff, novel surroundings and changes in husbandry routine are likely to contribute to the behavioral and physiological indicators of stress that are observed in the short term in dogs experimentally housed in isolation or in shelters (Beerda et al.,

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1997; Hennessy et al., 1998, 2001). Behavioral correlates of stress have also been observed in dogs sheltered for longer periods (Hubrecht 1992; Beerda et al., 1999a, 2000). For example, dogs were observed to display behaviors associated with frustration and depression eight weeks following admittance to a shelter (Stephen & Ledger, 2005).

About two third of dogs coming from a shelter display one or more behavior problems during the first month post-adoption (Wells & Hepper, 2000), and behavior problems represent one of the most common reasons for relinquishing dogs to shelters (Tuber et al., 1999). Therefore it is relevant to assess if and how dog behavior changes during the permanence in a shelter and if these changes are correlated with future behavior problems that dogs often display during the first period after adoption.

The aim of this study was to observe the presence and extent of any change in the sheltered dogs' behaviors based on an ethogram of such species borrowed from literature (De Palma et al., 2005; Beerda et al., 1999a; Gosling & Bonnenburg, 1998) for a better understanding of how to properly manage animals in a way that will protect their welfare and improve their future chances to be adopted early after admittance to the shelter.

## Materials and methods

The study was conducted at the public shelter of Lucca (Italy). This is equipped with individual boxes, consisting of an outdoor area (95 cm. wide, 140 cm. long, 170 cm. high) and an indoor area of the same size. The boxes, with a concrete floor, are cleaned every morning. Each dog can see the box in front of its own, and is fed, about at 4 p.m., with dry food and walked once a day.

### *Subjects*

A sample of fifteen crossbreed dogs (seven females and eight males) of an estimated age of two to eight years were analyzed. The use of mongrels prevented any valid analysis of breed differences (Wells et al., 2002). None of the dogs had docked tails. Organic and behavioral pathologies were ruled out for all dogs before admittance to the study protocol.

It was not possible to clearly document the source of many dogs, so no attempt was made to distinguish subjects on the basis of their provenance.

### *Procedures*

Starting on the third day after the dogs' admittance to the shelter, each subject was video-recorded for twenty minutes once a week for five times (T0, T1, T2, T3, T4) between 9.00h and 12.00h a.m. The video camera was placed in front of the outdoor area of the kennel, the only one left available during the video-recording. Shelter staff could not interact with the dogs or work near the box being filmed. This setting was selected so as to assess the dogs' spontaneous behavior in a standardised situation, which did not differ from a regular day. The videos were analyzed to measure the frequency and duration of 37 behaviors (De Palma et al., 2005) as described in Table 1. In addition, dogs underwent a behavioral test on the fifteenth and thirtieth day after admittance to the shelter. The dogs were not tested earlier, in order not to make them suffer the influence of the stress of the first few days. On both occasions, the test was conducted inside an unknown, closed room.

The test included three subtests, preceded by five minutes to let the dog get used to the environment. Each subtest, at five minutes' intervals from the next, consisted of introducing a specific stimulus. The subject was video-recorded by a hidden person for the subsequent assessment of the dog's behavioral responses according to a scale that kept into account five increasing levels of reactivity.

Table 1. Behaviors analysed in the dog's box (De Palma et al., 2005).

| **Behavior** | **Description** |
|---|---|
| Biting bars | Biting the box's bars |
| Ears up | Raising the ears turning them forward, showing attention to something |
| Ears backwards | Putting the ears backwards |
| Tail still | The tail is still and rigid at a medium height |
| Tail beetwen the legs | The tail is kept between the hind legs, covering genital organs |
| Waving tail | The tail is waved intensely |
| Waving high tail | The tail is waved while kept high |
| Indifferent towards the barking of other dogs | The dog is indifferent when the other dogs are barking |
| Getting frightened by noises | Being frightened by noises |
| Prompt | Ready to spring towards a stimulus with the ears raised, watchful eyes, the tail still and the whole body vibrating |
| Looking outside | Looking outside the box |
| Looking at the environment | Looking around the environment |
| Raising forelegs on wall | Raising both forelegs onto the wall or onto the bars, looking carefully outside |
| Sniffing air | Raising the head, moving the nostrils and breathing the air, to perceive odours |
| Sniffing environment | Putting the muzzle on the ground, on the wall, or on the objects in the box, the dog sniffs the environment |
| Scratching | Raising one hind leg and scratching itself vigorously |
| Yawing | Opening the mouth and inhaling and exhaling air |
| Circling | Running around circling itself. When this behavior is recorded in the box it might take the place of running |
| Licking lips | Passing the tongue on the lips |
| Licking objects persistently | The dog lick an object persistently |
| Jumpinng | Jumping with all four legs, falling down on the same place |
| Self-grooming | Cleaning itself with the tongue and the teeth |
| Barking | Vocalisation characteristic of dogs |
| Whining | A mournful vocalisation |
| Grumbling | A low and deep vocalisation that seems to come from the chest. The dog generally has the mouth closed |
| Howling | Vocalisation characteristic of wolves, this consist in a long, high and mournful sound; quite rare in dogs |
| Urinating | Emitting urine in a crouching position |
| Urinating with a raised leg | Emitting the urine with one hind leg raised, so that urine goes beside the |
| Urinate jumping | Emitting the urine while jumping |
| Scratching with hind legs | Scratching the round with the hind legs after having urinated or defecated |
| Lying down | Lying down on the ground |
| Crouching | Lying with the ventral region in contact with the ground |
| Sitting | Sitting down with the rump leaning on the ground |
| Upright | Standing up on four legs |
| Dozing | Curling up, the dog is half asleep |
| Scratching door | Scratching the door with a fore leg |
| Digging | Digging on the round with the fore legs, to make a hole |

First subtest (NOISE): an alarm clock rang suddenly for 10 seconds. The dog's behavioral responses were assessed according to the following scale:

1. No attention.
2. Slight attention, the dog moves its head.
3. Attention to the source of the noise, the dog turns with pricked-up ears.
4. Immediate attention, the dog turns to the source of the noise.
5. The dog quickly moves towards the source of the noise.

Second subtest (FOOD): some dry food, the same usually fed in the shelter, was thrown into the room, and the dog's behavioral response was assessed according to the following scale:

1. Does not explore.
2. Sniffs the food but keeps off it.
3. Sniffs the food and goes near it several times.
4. Sniffs the food, goes near it several times, and eats it.
5. Sniffs the food and eats it straightaway.

Third subtest (PLAY): a toy (ringing plastic toy) unknown to the animal was thrown into the room and left at the dog's disposal. The animal's responses were assessed according to the following scale:

1. No exploration.
2. Slight attention to the toy, no interaction.
3. The dog goes near the toy and sniffs it.
4. Interaction with the toy, without any special interest.
5. Active play.

### *Statistical Analysis*

The statistical analysis of data resulting from the observation of the dog's behaviors in its box in terms of duration and frequency was based on the linear regression test.

The similarity data analysis based on *non-metric Multi-dimensional-scaling* (MDS) (Kruskal, 1964; Kruskal & Wish, 1978; Clarke & Warwick, 2001) helped identify the dog's most common behaviors and their distribution and variation over time. In addition, DISTLM, a non-parametric multivariate analysis, was carried out (Anderson 2001, 2004; McArdle & Anderson, 2001), according to a mono-factorial ANOVA design with repeated measurements to test the effect of time (Fixed Factor with five levels, one per observation) on the whole of the behaviors. Because of the low number of possible permutations, due to the level of replication and the experimental design, a Monte Carlo simulation was used to obtain a significance value (Anderson & Robinson, 2003). The analysis was carried out on the square root of the data, in order to offset the weight of those behaviors that tended to last longer than those which are potentially as characteristic but tend to last less. SIMPER analysis was used to identify behaviors that appeared more frequently in each observational session.

The results of the behavioral test were analysed by comparing the mean value of the score given to the dogs in each test in both observations. In particular, because of the low number of subjects in the sample and the presence of many cases in which the score remained the same in both observations, the Friedman Test was used (Friedman, 1937).

## Results

The mean (± standard deviation) duration and frequency in the expression of the sheltered dogs' monitored behaviors are listed in Table 2 and 3.

Table 2. Mean values (±S.D.) of the duration of dogs' behaviors while in the box.

| **Behaviors** | **T 0** | **T 1** | **T 2** | **T 3** | **T 4** |
|---|---|---|---|---|---|
| Biting bars | 0.27±1.03 | 3.40±10.14 | 3.67±10.52 | 5.20±9.04 | 3.80±11.77 |
| Ears up | 49.47±51.92 | 40.27±94.23 | 18.33±36.77 | 21.47±29.17 | 56.33±86.58 |
| Ears backwards | 20.60±58.69 | 1.00±3.87 | 34.27±91.25 | 8.87±19.65 | 40.67±99.90 |
| Tail still | 298.13±462.90 | 210.53±429.64 | 340.87±537.21 | 192.20±420.68 | 200.40±420.68 |
| Tail beetwen the legs | 0.00 | 94.73±311.02 | 110±306.44 | 100.73±308.11 | 105±305.37 |
| Waving tail | 22.33±38.80 | 17.00±23.50 | 28.60±55 | 5.87±11.54 | 4.60±14.01 |
| Waving high tail | 25.27±87.10 | 25.47±70.02 | 7.47±22.28 | 5.27±19.06 | 0.93±3.61 |
| Indifferent towards barking of other dogs | 1167.60±49.06 | 1183.20±27.82 | 1172.87±33.02 | 1174.07±35.25 | 1124.4±114.28 |
| Getting frightened by noises | 10.53±40.80 | 1.53±5.94 | 1.80±6.97 | 1.53±5.94 | 18±34.62 |
| Prompt | 21.87±35.16 | 15.27±27.31 | 25.20±33.52 | 23.73±32.96 | 57.60±112.26 |
| Looking | 287.80±218.64 | 550.60±292.31 | 498.27±281.90 | 457.93±337.64 | 434.20±321.91 |
| Looking at the environment | 302.33±234 | 261.67±210.10 | 240.80±239.79 | 328.33±295.73 | 38.13±67.41 |
| Raising forelegs on wall *o* | 53.20±139.47 | 34.87±30.55 | 24.93±30.11 | 39.27±53.58 | 47.40±45.66 |
| Sniffing air | 23.20±21.09 | 16.47±22.22 | 8.07±7.71 | 8.93±8.40 | 18.60±15.95 |
| Sniffing environment | 82.27±128.25 | 66.53±51.10 | 50.80±46.98 | 67.73±63.37 | 67.53±65.75 |
| Scratching | 2.07±4.61 | 6.00±21.38 | 4.27±6.49 | 3.93±7.72 | 5.40±8.81 |
| Circling | 78.07±263.75 | 24.73±31.98 | 28.60±23.24 | 36.73±29.21 | 33.93±26.35 |
| Licking objects persistently | 0.60±2.32 | 0.00 | 0.00 | 0.93±3.61 | 1.20±4.65 |
| Jumping | 2.13±4.76 | 1.33±2.89 | 2.60±6.39 | 4.53±4.90 | 3.20±5.17 |
| Self-grooming | 25.87±35.29 | 12.53±18.05 | 18.33±31.79 | 18.93±36 | 2.07±4.56 |
| Barking | 16.73±20.74 | 27.07±56.32 | 40.20±69.38 | 113.47±279.16 | 47.67±72.75 |
| Whining | 117.07±247.94 | 106.33±189.46 | 112.80±154.02 | 78.47±87.57 | 146.07±296.36 |
| Grumbling | 50.07±128.30 | 18.27±52.85 | 9.67±19.31 | 26.00±82.80 | 6.13±11.57 |
| Howling | 15.13±46.21 | 9.00±16.20 | 10.00±24.97 | 14.20±26.71 | 13.07±27.49 |
| Urinating | 1.40±3.70 | 0.67±2.58 | 0.00 | 1.27±3.47 | 2.47±5.11 |
| Urinating with a raised leg | 1.20±3.69 | 2.20±8.52 | 0.20±0.77 | 0.00 | 0.00 |
| Urinate jumping | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Scratching with hind legs | 0.00 | 0.00 | 0.20±0.77 | 0.93±3.61 | 2.33±4.64 |
| Lying down | 259.9±372.46 | 164.67±278.29 | 108.07±220.50 | 111.47±238.53 | 63.60±170.23 |
| Crouching | 146.07±215.38 | 137.60±206.16 | 117.73±224.94 | 95.33±158.04 | 103.40±258.98 |
| Sitting | 220.13±153.24 | 303.40±355.88 | 333.33±303.77 | 347.87±361.57 | 350.73±258.18 |
| Upright | 573.87±348.69 | 594.33±352.97 | 694.20±492.16 | 645.33±354.08 | 682.27±332.66 |
| Dozing | 186.20±206.97 | 143.67±247.46 | 117.53±176.76 | 83.67±169.11 | 10.67±32.50 |
| Scratching door | 3.33±5.15 | 7.00±14.47 | 8.33±10.32 | 21.13±30.68 | 37.73±47 |
| Digging | 0.47±1.81 | 0.00 | 2.67±8.37 | 1.80±3.17 | 4.80±5.73 |

Table 3. Mean values (±S.D.) of the frequency of dogs' behaviors while in the box.

| **Behaviors** | **T 0** | **T 1** | **T 2** | **T 3** | **T 4** |
|---|---|---|---|---|---|
| Biting bars | 0.07±0.26 | 0.53±1.46 | 0.60±1.55 | 1.13±2.03 | 1±3.07 |
| Ears up | 1.60±1.50 | 0.93±1.28 | 0.93±1.83 | 1.60±1.96 | 1.87±2.39 |
| Ears backwards | 0.20±0.41 | 0.07±0.26 | 1.20±1.82 | 0.93±1.83 | 1.40±1.80 |
| Tail still | 0.67±0.72 | 0.53±0.64 | 0.53±0.83 | 0.60±1.55 | 0.80±1.66 |
| Tail beetwen the legs | 0.00 | 0.40±1.30 | 0.87±1.51 | 0.40±0.63 | 1.27±1.67 |
| Waving tail | 1.13±1.85 | 0.93±0.96 | 1.00±1.51 | 0.33±0.62 | 0.20±0.56 |
| Waving high tail | 0.73±1.71 | 0.80±1.93 | 0.47±1.30 | 0.27±0.80 | 0.07±0.26 |
| Getting frightened by noises | 0.07±0.26 | 0.07±0.26 | 0.13±0.52 | 0.20±0.77 | 0.80±1.70 |
| Prompt | 0.87±1.36 | 0.73±1.10 | 0.93±1.28 | 1.00±1.31 | 0.93±1.22 |
| Looking outside | 7.13±4.53 | 8.80±3.34 | 8.73±3.49 | 7.87±3.09 | 6.87±4.36 |
| Looking at the environment | 7.07±4.33 | 6.80±3.51 | 6.07±3.69 | 6.67±2.82 | 5.33±3.22 |
| Raising forelegs on wall | 4.13±4.63 | 4.93±2.96 | 3.80±3.21 | 5.33±6.97 | 7.13±6.09 |
| Sniffing air | 2.47±1.77 | 2.27±2.60 | 1.40±1.35 | 1.47±1.30 | 2.53±1.55 |
| Sniffing environment | 4.53±3.00 | 4.67±3.02 | 4.80±2.11 | 4.67±2.77 | 4.67±3.15 |
| Scratching | 0.40±0.83 | 0.33±1.05 | 0.80±1.21 | 0.87±1.64 | 1.00±1.56 |
| Yawning | 1.13±1.25 | 0.53±0.92 | 1.20±1.32 | 1.00±1.56 | 3.47±3.18 |
| Circling | 1.87±1.77 | 4.73±3.22 | 6±3.89 | 7.40±4.12 | 8.07±5.32 |
| Licking lips | 1.40±1.80 | 3.07±6.99 | 1.07±1.16 | 0.73±1.28 | 1.67±1.84 |
| Licking objects persistently | 0.13±0.52 | 0.00 | 0.00 | 0.13±0.52 | 0.27±1.03 |
| Jumping | 0.80±1.78 | 0.53±1.06 | 0.80±1.82 | 1.47±1.46 | 1.20±2.01 |
| Self-grooming | 2.07±2.22 | 3.27±5.19 | 1.27±1.79 | 1.07±1.87 | 0.53±1.25 |
| Barking | 2.60±3.02 | 3.27±5.19 | 3.87±6.12 | 4.60±6.68 | 4.20±4.33 |
| Whining | 3.00±3.16 | 4.13±4.61 | 5.20±4.63 | 4.93±4.67 | 3.60±3.42 |
| Grumbling | 1.80±3.28 | 1.20±2.31 | 0.93±1.91 | 1.33±3.13 | 1.00±1.93 |
| Howling | 1.60±4.27 | 1.13±1.68 | 1.47±3.23 | 1.53±2.50 | 1.93±3.92 |
| Urinating | 0.20±0.56 | 0.13±0.52 | 0.00 | 0.13±0.35 | 0.27±0.59 |
| Urinating with a raised leg | 0.33±0.90 | 0.07±0.26 | 0.07±0.26 | 0.00 | 0.00 |
| Urinate jumping | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Scratching with hind legs | 0.00 | 0.00 | 0.07±0.26 | 0.20±0.77 | 0.47±0.83 |
| Lying down | 1.40±1.84 | 1.13±2.03 | 0.73±1.49 | 1.00±2.33 | 0.87±1.51 |
| Lying down | 1.40±1.84 | 1.13±2.03 | 0.73±1.49 | 1.00±2.33 | 0.87±1.51 |
| Crouching | 0.67±0.90 | 1.20±1.61 | 1.07±1.71 | 0.87±1.36 | 1.27±2.52 |
| Sitting | 3.53±2.53 | 3.87±3.85 | 4.73±3.75 | 5.87±4.27 | 7.87±4.47 |
| Upright | 4.67±2.72 | 6.27±3.90 | 5.93±3.69 | 6.93±3.49 | 7.33±4.15 |
| Dozing | 1.13±1.41 | 1.00±1.65 | 0.93±1.58 | 0.40±0.63 | 0.13±0.35 |
| Scratching door | 0.80±1.08 | 1.80±3.43 | 2.33±4.32 | 3.20±4.81 | 4.53±4.49 |
| Digging | 0.13±0.52 | 0.00 | 0.27±0.70 | 0.53±0.92 | 1.00±1.36 |

As to the duration of such behaviors, the data analysis showed a statistically significant increase of some behaviors, such as scratching door (r=0.93; p=0.023) and digging (r=0.86; p=0.060). At the same time, a decrease was observed in the duration of lying down (r=0.93; p=0.021), dozing (r=0.98; p=0.003) and waving high tail (r=0.93; p=0.019). Some of the behaviors that might suggest

a state of activity increased in frequency. This happened especially for standing upright (r=0.92; p=0.026), scratching door (r=0.99; p=0.001), digging (r=0.91; p=0.034), whining (r=0.92; p=0.024), and scratching (r=0.93; p=0.024). In addition, a significant reduction was observed in the frequency of dozing (r=0.95; p=0.01), waving tail (r=0.92; p=0.02) and waving high tail (r=0.95; p=0.01).

No statistically significant difference was observed in the other monitored behaviors.

The similarity analysis of the MDS data showed that samples from the five observational sessions presented no clear segregation but rather a behavioral gradient. Using the Monte Carlo simulation, the data analysis showed a significant effect of the time factor in the variation of the overall behavior (p=0.004).

The SIMPER analysis helped instead to single out the characteristic behaviors of each observation by determining, in each observational session, which ones were most frequent and characteristic of the different phases of the dog's stay in the shelter. Table 4 lists the average percentage of time spent by the dogs in displaying the most frequent behaviors during the observational sessions.

Table 4. Average percentage of time spent by dogs in displaying the most frequent behaviors.

| **Behaviors** | **T 0 %** | **T 1 %** | **T 2 %** | **T 3 %** | **T 4%** |
|---|---|---|---|---|---|
| Indifferent towards the barking of other dogs | 48.60 | 48.88 | 46.93 | 48.30 | 45.53 |
| Upright | 15.66 | 15.56 | 16.82 | 17.69 | 20.42 |
| Looking outside | 7.36 | 15.76 | 13.18 | 10.90 | 10.25 |
| Looking environment | 7.30 | 6.08 | 4.48 | 6.98 | 4.22 |
| Sitting | 5.58 | 5.58 | 6.86 | 6.67 | 8.91 |
| Dozing | 2.91 | 1.14 | 1.31 | - | - |
| Lying down | 2.87 | 1.37 | - | - | - |
| Tail still | 2.44 | 1.05 | 2.74 | - | 0.87 |
| Crouching | 1.52 | 1.42 | 0.80 | 0.83 | - |
| Sniffing environment | 1.15 | 1.53 | 1.05 | 1.51 | 1.38 |
| Whining | - | - | 1.31 | 1.30 | 1.42 |
| Circling | - | - | - | 0.84 | 0.82 |
| Raising forelegs on wall | - | - | - | - | 0.99 |
| Scratching door | - | - | - | - | 0.63 |

The analysis shows that the five observations are basically characterised by the same behaviors. However, observations following the first one showed the appearance of behaviors which suggest increasing levels of activity: this is the case of circling (which appeared at the fourth observation), scratching door and raising forelegs on wall (which appeared at the 5$^{th}$ observation).

In addition, among the characteristic behaviors, some indicators associated with inactivity, such as dozing, crouching and lying down, disappeared between T2 and T4.

Table 5 lists the ratios of similarity to the standard deviation (S.D.) of each behavior in the different observations: the indicator matches the absolute contribution with the similarity and variability of a given behavior shown by the dogs, where higher values are taken by those behaviors, which are more consistently expressed within the group.

Some individual variability can be observed in the expression of activity behaviors, which increase as the dog remains in the shelter, and inactivity behaviors, which remarkably decrease over time.

Table 5. Ratios of the similarity of individual behaviors over the weeks to the standard deviation.

| **Behaviors** | **T 0 Sim/SD** | **T 1 Sim/SD** | **T 2 Sim/SD** | **T 3 Sim/SD** | **T 4 Sim/SD** |
|---|---|---|---|---|---|
| Indifferent towards the barking of other dogs | 8.24 | 9.02 | 9.16 | 9.33 | 5.89 |
| Upright | 1.47 | 1.67 | 1.91 | 1.70 | 2.11 |
| Looking outside | 1.56 | 1.73 | 1.55 | 1.53 | 1.54 |
| Looking environment | 1.02 | 0.97 | 0.85 | 1.06 | 0.86 |
| Sitting | 1.13 | 0.56 | 0.94 | 0.74 | 1.02 |
| Dozing | 0.59 | 0.31 | - | - | - |
| Lying down | 0.44 | 0.31 | - | - | - |
| Tail still | 0.35 | 0.21 | 0.30 | - | 0.20 |
| Crouching | 0.36 | 0.41 | 0.23 | 0.28 | - |
| Sniffing environment | 0.91 | 1.35 | 1.18 | 1.20 | 0.89 |
| Whining | - | - | 0.57 | 0.67 | 0.68 |
| Circling | - | - | - | 1.08 | 1.10 |
| Raising forelegs on wall | - | - | - | - | 0.95 |
| Scratching door | - | - | - | - | 0.81 |

Table 6 lists the mean scores (± S.D.) given to the dogs during the behavioral tests and the statistically-significant differences found by using the Friedman's test.

Table 6. Mean scores (± S.D.) obtained by the dogs at the behavioral test and statistical differences at the Friedman's test.

| **Test** | **15$^{th}$ day** | **30$^{th}$ day** | **p** |
|---|---|---|---|
| Noise | 3.27±1.16 | 1.80±0.94 | $\chi^2$= 8.33 p= 0.004 |
| Food | 2.80±1.37 | 3.60±1.72 | $\chi^2$= 1.6 p = 0.21 |
| Play | 3.00±0.65 | 2.60±1.30 | $\chi^2$= 3.6 p= 0.06 |

The dogs showed a highly significant decrease in reactivity to the noise. The same trend was noticed for the play subtest.

## Discussion

The behavior of every living being has developed in connection with the environment in which the species has evolved, so as to adapt to it in a way that protected its individual wellbeing (Moberg, 2000). Some animal species, such as the dog, show a high ability to adapt their behavior in response to the environment conditions. These are the resources the dog implements when housed in a shelter, where it often experiences a number of potentially stressful conditions. As a matter of fact, even in a well-run and caring shelter, dogs are exposed to a high level of novelty and noise (Wells et al., 2002); they are separated from any previous attachment and their environment becomes unpredictable and uncontrollable (Hennessy et al., 2001). These and other factors can remarkably affect the dog's welfare and make the dog change its behavior in the attempt to adapt to the new circumstances.

Studies conducted on the dog have showed the onset of new behaviors in dogs that were experimentally kept in a poorly-stimulating environment and segregated from their conspecifics for 6 weeks (Beerda et al., 1999a). The transition to these housing conditions resulted in a significant increase in the dog's interaction with the environment, often in the form of repetitive, mechanical behaviors and oral behaviors (Beerda et al., 1999a and b). Similar results have also been shown by this study, which found that the dog's behaviors progressively changed in the first month in which it stayed at the kennel. A decrease was actually found in the duration and/or frequency of inhibited and passive behaviors (such as dozing and lying down) which the dogs usually have when faced with a new situation, while an increase was observed in the active behaviors (upright, scratching door and digging).

Other behaviors that were modified by the dog's confined conditions, in the study of Beerda et al. (1999a), were an increase in the frequency of auto-grooming, circling, eating faeces and paw lifting. These behaviors went hand in hand with an increase in the levels of cortisol in the saliva (Beerda et al., 1999b). Other Authors too report that self-grooming (Hetts et al., 1992) and scratching (Hiby et al., 2006), as well as barrier manipulation (Hetts et al., 1992), increase in individually-stabled dogs confined to narrow spaces. We can assume, therefore, that even in this study social isolation might be the cause or one of the causes of the rise in the frequency of behaviors that are potential stress indicators, such as whining and scratching.

The animal's growing state of activity and greater interaction with the environment, even if they are the dog's response to unfavourable environment conditions, should be carefully monitored, since they might be early indicators of the development of behavioral problems. Previous studies demonstrated that behavior observed in animal shelters can be related to behavior problems after adoption (van der Borg et al., 1991), above all when dogs are young, with distorted responses to behavioral tests (Hennessy et al., 2001). Other studies suggest that dogs acquired from a rescue shelter are more likely to exhibit problem behaviors than other sources of acquisition; e.g. they are particularly prone to separation-related problems (McCrave, 1991), as well as to hyperactivity (37.4%) and destructive tendencies (24.5%) (Wells & Hepper, 2000). These behavioral changes might actually be caused by some of the behaviors that have been observed during the dog's comparatively short stay in a shelter, as it happened in this study. We could assume that, as suggested by other Authors (Hetts et al., 1992; Hubrect et al., 1992), caging dogs alone is a cause of animal boredom, understimulation and development of behavior problems.

Another important consideration is that the observed behavioral changes are not macroscopic. The SIMPER analysis actually demonstrated that over 80% of the observation time was taken up with mostly unchanged behaviors during the observational sessions. Only a careful observation could detect any statistically significant changes in the duration of such behaviors as scratching door, digging, lying down, dozing and waving high tail, which could therefore be regarded as indicators of early behavioral changes in the animal.

Regarding the test, behavioral changes were observed in the dog at the 'sudden sound' subtest, in which the animal showed less reactivity in the second test than in the first one. This might be accounted for by the animal's getting used to such stimuli during the time spent in an environment full of intense sound stimuli, such as the kennel is (Sales et al., 1997). For the 'play' subtest too, the response was one of greater apathy (verging on statistical significance) during the second measurement; this might be construed as the dog's losing interest in stimuli which are usually motivating for the dog, such a play, because of the social isolation in which the dog lives when in the shelter.

The presence of gender differences was not analysed because of the small number of available subjects. However the considerations made by Beerda et al., (1999a), according to whom gender did not affect the chronic stress behavioral responses to social and spatial restriction, probably apply.

This study provided a better understanding of the alterations that can be observed in some of the dog's behaviors when in the shelter, which should be assessed through accurate monitoring. In the

shelter, after a first stage in which the animals are inhibited by the unpredictability of the environment events, social and otherwise, the dogs become active again. The lack of guidance and social organisation leads them to implement adaptation strategies that are independent on their interaction with a partner, human or canine. The lack of feedback, guidance and control, which occurs when the dog responds to external stimuli, might contribute to the onset of behaviors that are hardly compatible with life in a human household. In addition, it can be assumed that, in dogs that stay in the shelter for a long time, some of the observed behavioral changes might become chronic and might be indicators of the animal's poor state of welfare. A further investigation is however required to see if there may be any correlation between the observed behavioral changes and other parameters that are universally recognised as stress indicators, so that such behavioral changes might be used as potential indicators of the state of welfare of shelter dogs.

In conclusion, special measures should be taken in shelters, including paying special attention to the changes of dog's behavior. To do this, shelter staff should be appropriately trained to detect the hardly-detectable early signs that have been observed in this study. In addition, measures should be taken to reduce the dogs' likelihood to develop behavioral problems that might become difficult to manage and cause the dog to go back to the shelter after adoption. For instance, by maintaining and promoting the dogs' correct intra- and inter-specific socialisation, as well as training them, to increase adoptability for shelter dogs (Luescher et al., 2007).

Finally, measures should be taken regarding the shelter environment and housing conditions. It is well known that stress may be reduced in the shelter by adding environmental enrichment (i.e toys, beds, companionship, food, and complexity to the enclosure), allowing for social interaction (human and conspecific) and providing adequate exercise (Normando et al., 2004; Wells, 2004; Coppola et al., 2006). For example, enriching their environment with objects that can be chewed, moved around with paws and carried around (Hetts et al., 1992) might reduce their bar-chewing or ground-digging behaviors.

The results suggest that, for the animal's welfare to be protected, more attention should be paid to the caged environment of the sheltered dogs in an attempt to reduce the likelihood of dogs developing behavior problems whilst in captivity. It is obvious, however, that the most effective way to improve the long-term welfare of a sheltered dog is to ensure that the animal is adopted (Wells & Hepper, 2000) and that it can live its relation with man to the fullest, as is in its nature.

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## Modificazioni del comportamento in cani ospitati in canile

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*Sintesi*

Lo scopo del presente studio è stato quello di valutare se la permanenza in canile sanitario può causare cambiamenti comportamentali nei cani osservati. Sono stati video-registrati quindici cani meticci per venti minuti ciascuno, nel proprio box, una volta alla settimana per cinque volte iniziando dal terzo giorno dall'arrivo in canile.

E'stata osservata un riduzione nella frequenza di comportamenti quali il sonnecchiare (r=0,95; p=0,01), lo scodinzolare a coda alta (r=0,95; p=0,01), lo scodinzolare (r=0,92; p=0,02); inoltre è stata osservata una riduzione della durata dello stare sdraiato (r=0,93; p=0,021), del sonnecchiare (r=0,98; p=0,003) e dello scodinzolare a coda alta (r=0,93; p=0,019). Oltre a ciò è stato osservato un aumento nella durata di alcuni comportamenti quali il grattare la porta (r=0,93; p=0,023) e lo scavare per terra (r=0,86; p=0,060). Infine è stata osservato un aumento significativo della frequenza dello stare alzato (r=0,92; p=0,026), del grattare la porta (r=0,99; p=0,001), dello scavare per terra (r=0,91; p=0,034), dell'uggiolare (r=0,92; p=0,024) e del grattarsi (r=0,93; p=0,024).

A partire dalla terza e quarta settimana sono apparsi alcuni comportamenti tipici di uno stato di irrequietezza, mentre sono scomparsi altri comportamenti di inattività.

I cani, durante il periodo di osservazione, sono stati sottoposti ad un test comportamentale che consisteva nell'introduzione di differenti stimoli (rumore improvviso, cibo e gioco) in un luogo sconosciuto; il test ha dimostrato come i soggetti si abituassero a stimoli esterni come ad esempio il rumore improvviso (p=0,004).

I dati ottenuti suggeriscono che la permanenza in canile può indurre cambiamenti del comportamento che andrebbero attentamente monitorati per prevenire eventuali problemi che potrebbero svilupparsi dopo l'adozione.

# Effects of different human approaches on dog's behavior: preliminary results

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*Abstract*: The study of dogs' responses to an approaching human plays an important role for the development of human-dog relationship.

The aim of the research was to develop a protocol for a behavioral test in order to assess the behavioral responses of dogs to two different approaches performed by an unknown man.

Twenty-five dogs of different breeds or mixed-breed, 17 females and 8 males, 56.4±26.2 months old, underwent a behavioral test in which a male stranger approached the subject using two different modalities, named indirect approach (IA) and direct approach (DA).

Test were video recorded and dogs' responses to the approaching man were analyzed in order to attribute the following scores: aggressive (=1), active avoidant (=2), passive avoidant (=3), ambivalent (=4), neutral (=5), or friendly (=6). In addition, each videotaped session was analysed with the continuous sampling method registering the duration (s) of 11 behaviors: nose licking, paw lifting, yawning, blinking, and body shaking (their duration was summed and used as a measure of dog stress); orientation toward the stranger, barking, and growling (their duration was summed and used as a measure of the attitude toward the unknown man); orientation toward the owner, approach and contact with the owner (their duration was summed and used as a measure of the attitude toward the owner). Statistical analysis was performed using Wilcoxon test ($p<0.05$) in order to compare responses to DA and IA and the duration of behaviours during DA and IA.

Dogs responded in a more friendly way to IA than to DA ($Z=-2.049$, $p=0.021$). For stress signals, the time was higher for DA, respect to IA, although the differences did not reach statistical significance ($Z=-1.280$, $p=0.201$). Concerning the attitude toward the stranger, significant differences between DA and IA were found ($Z=2.64$, $p=0.008$), i.e. dogs looked at the stranger, barked and growled more during DA. As regards to the behaviors towards the owner, no statistically significant difference between the two approaches was observed.

These preliminary results seem to show that dogs behave in a more friendly way towards strangers when approached in an indirect way. DA seems to be more stressful for dogs, likely because it is perceived as more threatening.

*Key Words*: human approach, stress, dog, behavior.

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## Introduction

Dogs, like humans, are a social species; from sexual to predatory behavior, from urine marking to mutual grooming, the subtleties for much of the canine daily life are based on social relationships (Beaver, 2009). Communication among individuals is fundamental during management of the social relationship. Considering the long domestication history of the dog, it is not surprising that this animal has improved efficient communicative skills also in the relationship with the human being: according to Kubinyi et al. (2007), "the social niche of family dogs is the human social environment".

Dog use different communicative channels, from postural communication to vocalizations. They emit a variety of sounds to communicate with conspecifics and humans. Beaver (2009) listed

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seventeen types of vocalization; among these are bark and growl, used in various circumstances, not only during agonistic interactions (see Simpson, 1997; De Palma et al., 2005; Yeon, 2007).

Visual communication is also widely used. Dogs, in fact, utilize a broad variety of body postures to communicate and they are skilful at reading subtle changes (Beaver, 2009). This is true for both dog-dog and dog-human interactions; in fact, dogs' ability to understand, react and rely on human gesture was confirmed by several studies (e.g. see Hare et al., 2002; Dalla Costa et al., 2008; Riedel et al., 2008).

Moreover, canids can display distance-reducing signals such as avoiding direct eye contact, lowering head and neck, positioning the tail between the legs and raising foreleg (Fox, 1969; Beaver, 2009). Other postural signs are, instead, functional to increase the distance between the sender and the receiver. Some of agonistic behaviors described in wolf, like moving the opponent away, inhibited bite, aggressive gape and staring (Beaver, 2009) are present in dogs but are not fully expressed in all canine breeds (Goodwin et al., 1997).

Several authors recognized some particular behaviors as possible indicators of stress, such as yawning, body shaking (Beerda et al., 1998), looking elsewhere (Rooney et al., 2009), turning head, nose liking, paw lifting (Schildler & van der Borg, 2004). Rugaas (2005) firstly speculated these and other signals (e.g. blinking) could have a calming function, reducing the aggressive motivation in the dog, as other authors have afterwards demonstrated (Gazzano et al., 2014). Many dog trainers and behaviorists (see Chapman et al., 2000; Mariti et al., 2011), inspired by observing the mode of communication existing among dogs, recommend approaching the dog in a way defined as "indirect", following a non-frontal trajectory, without staring him in the eyes and with normal and calm gait. This type of approach could be less fearful for the dog as opposed to a frontal approach (direct approach) in which the person leans over the dog and stares at him.

In recent years, several experimental studies have focused on the interaction between man and dog. Lore & Heisemberg (1986) evaluated reactions of male and female dogs to unfamiliar humans; Wells & Hepper (1999) studied kennel dogs' responses towards the presence of men and women standing at the front of the cage, in a manner typical of a shelter visitor; Barrera & colleagues (2010) tested shelter dogs and pet dogs during an interaction with an unknown woman acting passively initially and actively later.

Vas and colleagues (2005) have developed an experimental protocol in which an unknown woman approaches a dog in a "friendly" and "threatening" way. The dog was tied to a tree and the owner was located about a meter away, behind the dog. The friendly way consisted in a frontal approach, during which the woman tried to maintain eye contact with the dog, trying to pet the dog and bending over him. In the threatening approach the woman was moving slowly and haltingly with slightly bent upper body and she was looking steadily into the eyes of the dog. The majority of dogs showed cues of tolerant, friendly behaviors upon friendly approach by the stranger; many of them gave various signs of avoidance or aggressiveness when the stranger approached them threateningly. However friendly approach reported by Vas (2005) is quite different from that commonly indicated as indirect and considered the best one.

The aim of the research was to develop a protocol for behavioral test in order to assess the behavioral responses of dogs to two different approaches (direct and indirect) performed by an unknown man.

## Subjects, materials, and methods

### *Subjects*

Twenty-five dogs, 8 males (2 neutered) and 17 females (8 spayed), from different breeds and mixed-breed (5 Labrador Retriever, 4 Golden Retriever, 1 Australian Kelpie, 1 German Sheperd, 1 Dogo Argentino, 1 Border Collie, 1 Beagle, 1 Springer Spaniel, 1 Bracco Italiano, 1 Flat Coated

Retriever, 8 mixed-breed) were involved in the study. The owners were volunteers recruited by personal contact.

All subjects were adults (56.4±26.2 months old) and free from behavioral and organic disorders. None of the females was in oestrus or pregnant around the time of observation.

In order to gather information on dogs and their characteristics, owners were asked to complete a questionnaire (including owner data, dog description and management, activities carried out with the owner, dog reaction to people and other dogs).

### *Participants*

- owner with the dog on a 60 cm long leash;
- "stranger", i.e. a man unknown to the dog. The stranger had never met the dogs before the present study.

Two trained behaviorists ("operators") were present in the setting during the test: they managed the cameras, gave instructions to the owner, and wrote down the timing of the phases of the test.

### *Setting and procedures*

Each dog was tested twice in two consecutive tests, consisting in a direct approach (DA) and in an indirect one (IA) performed by the stranger, in a random sequence. Tests were performed at Veterinary Sciences Department, University of Pisa, in a fenced field, measuring 20 x 30 m, unknown to the dogs, equipped with hedges, walls and a gate. Hedges and walls allowed the stranger to hide the sight from the dog's sight before entering the gate.

The owner entered the test field with the dog on the leash and let the dog explore the field for two minutes, then he was positioned, with his animal, at 10 meters from the gate. He was asked to stand still and to leave the leash as loose as possible; in case the dog went towards the stranger, the leash was held taut.

The stranger whistled to attract the dog's attention and entered the field via the gate. In IA, the stranger moved towards the dog with a semicircular traiectory, avoiding eye contact, until reaching the distance of 1.5 m from the dog, as indicated by a sign on the ground. Once the stranger got to this point, he stood for 10 seconds showing his side to the dog.

In DA the stranger walked in a straight line staring at the dog and then he stood with his front side facing the dog, still staring into the eyes of the animal.

In both types of approach, at the end of the procedure the stranger moved away along the same initial path. All tests were filmed using two cameras (JVC® GZ-MG 130E) mounted on a tripod.

Between the two approaches, the dog walked on a leash with the owner in the field for 3 minutes.

### *Data collection from videos*

Two trained observers watched the videos (100 sessions: 4 test x 25 dogs) to make a holistic evaluation of dogs' response to the approach. The possible dog responses were (modified from Vas et al., 2005):

- *Neutral response*: the dog is immobile, looking at the stranger, without wagging.
- *Friendly response*: the dog looks at the stranger (remaining still or moving towards him); he can wag without aggression signals or jumping on the stranger, looking for a physical contact.
- *Passive avoidant response*: the dog is still and he avoids looking at the stranger.
- *Active avoidant response*: the dog moves away from the stranger, looking at him or not, showing escape attempts or trying to hide behind the owner. The dog can yelp.
- *Ambivalent response*: the dog approaches and moves away from the stranger.
- *Aggressive response*: the dog growls or barks.

In addition, each videotaped session was analyzed with the continuous sampling method, registering the duration (s) of 11 behaviors (see Table 1).

Table 1. Description of dog behaviors and relative references.

| Behavior | Definition | References |
|---|---|---|
| Yawning | The dog opens his mouth, breathing in and out in quick succession | Modified from Beerda et al., 1998; Hennessy et al., 1998 |
| Nose/lips licking | The dog licks the upper part of the muzzle | Modified Schilder & van der Borg, 2004 |
| Blinking | Shutting and opening the eyes rapidly | Rugaas, 2005 |
| Contact with owner | Any physical contact with the owner | Modified from Topàl et al., 1998 |
| Approach the owner | The dog approaches the owner | Present study |
| Barking | Dog characteristic vocalization | De Palma et al., 2005 |
| Paw lifting | A fore paw is lifted, the other legs are on the ground | Modified from Beerda et al., 1998 |
| Growling | Low frequency vocalization; the dog bares his teeth | Horvath et al., 2007 |
| Body shaking | The dog shakes his body | Beerda et al., 1998 |
| Orientation toward the owner | Looking (direction of the head) at owner, even if the behavior is not reciprocal | Modified from Horvath et al., 2007 |
| Orientation toward the stranger | Looking (direction of the head) at stranger, even if the behavior is not reciprocal | Modified from Horvath et al., 2007 |

### *Data analysis*

All statistics were run with the software SPSS® Statistic 17.0 (Chicago, IL, USA).

Dogs' responses were scored as follows: aggressive (=1), active avoidant (=2), passive avoidant (=3), ambivalent (=4), neutral (=5) or friendly (=6). Statistical analysis was performed using Wilcoxon test ($p<0.05$) in order to compare responses to DA and IA.

Statistical analysis of dog behaviors concerned the duration (s) of:

- nose licking, paw lifting, yawning, blinking, and body shaking, named "stress signals" (their durations were summed and used as a measure of dog stress);
- orientation toward the stranger, barking, and growling (their durations were summed and used as a measure of the attitude toward the unknown man);
- orientation toward the owner, approach and contact with the owner (their durations were summed and used as a measure of the attitude toward the owner).

The analysis on such behaviors was performed on the whole test and dividing the test in two phases, named walking phase (i.e. stranger walking towards the dog) and closeness phase (i.e. stranger standing at the side or in front of the dog).

Wilcoxon test ($p<0.05$) was used to compare dogs' behavior in DA and IA.

## Results

A high level of agreement (88%) between the two observers was obtained for the analysis of response to the approaching man.

Figure 1 shows median values (horizontal line), 1st and 3rd quartile (box), minimum and maximum values (whisker), outliers (dot), and extreme values (asterisk) of scores obtained by dogs in DA and IA. Wilcoxon test revealed that dogs responded in a more friendly way to IA that to DA (Z=-2.049, p=0.021).

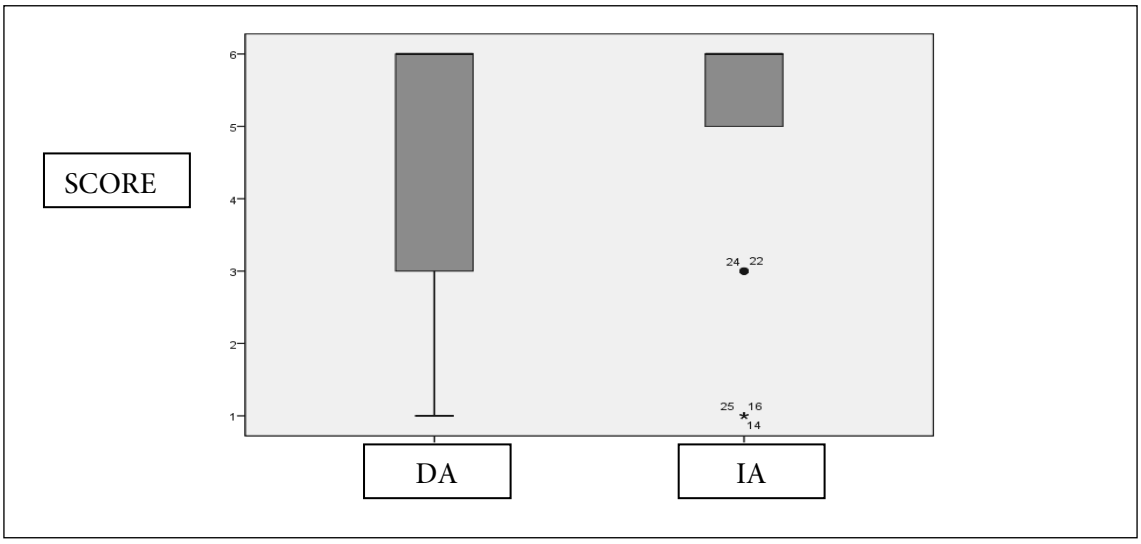


Figure 1. Dogs' response (from score 1= aggressive to score 6 = friendly) to DA and IA.

Figure 2 shows the amount of time spent displaying stress signals in DA and IA. When analyzing the whole test and the two different phases of the test (the walking and the closeness phase), the time was higher for DA, respect IA, although the differences did not reach statistical significance (Z=-1.280, p=0.201; Z=-0.975, p=0.330; Z=-0.286, p=0.775).

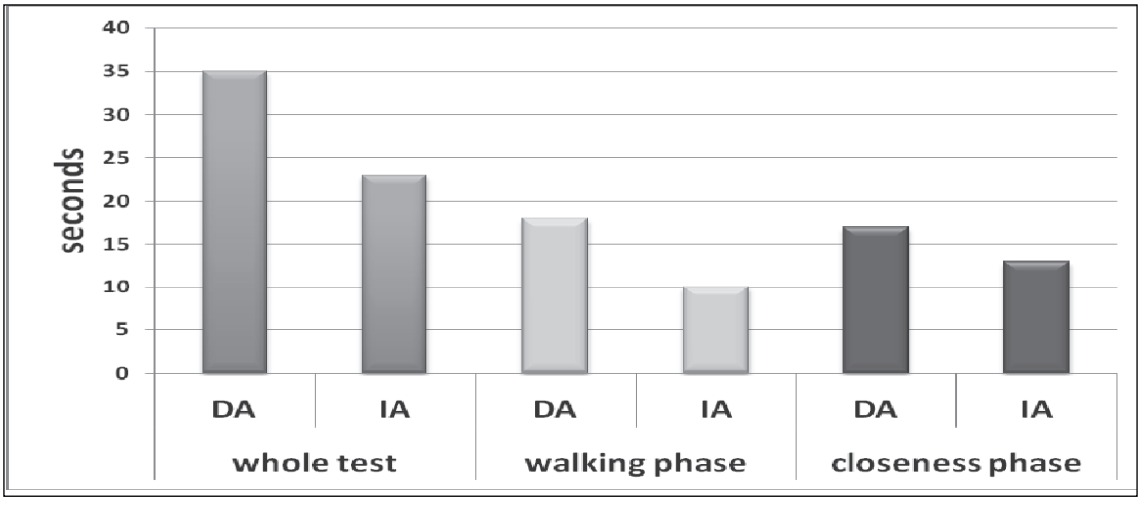


Figure 2. Time (s) spent exhibiting stress signals during the whole test and in the two different phases of the test.

Concerning the attitude toward the stranger, significant differences between DA and IA were found for the whole test (median 15 *vs* 12; Z=2.64, p=0.008) and the closeness phase (median 8 *vs* 3; Z=3.271, p=0.001), i.e. dogs looked at the stranger, barked an growled more during DA. No significant differences were found for the walking phase: median 8 *vs* 9; Z=0.586, p=0.558.

Regarding the attitude toward the owner, no significant differences between DA and IA were found for the whole test (median 6 *vs* 14.5; Z=1.400, p=0.162) and the walking phase (median 0 *vs* 0; Z=0.338, p=0.735). Considering the closeness phase, Wilcoxon test revealed that dogs displayed such behaviors more during IA (3rd quartile 0 *vs* 1; Z=2.240, p=0.025).

## Discussion

The study of the dog's reactions to the approach of strangers is crucial as it allows the person to figure out how best to interact with the animal to prevent fear and stress and to avoid aggressive responses. In literature, there are few experimental studies on this aspect. Vas et al. (2005), for example, proposed a "friendly" approach quite different from that commonly suggested and considered the best. Moreover, the dog was tied to a tree and the owner was positioned at a certain distance from the dog behind it.

In the present research, the friendly indirect approach was distinguished from direct approach better than in Vas' study; in addition, as dogs usually meet people when they are on the leash, this research simulated such condition. This difference is likely to have a strong impact on the dog response to strangers, because the owners may act as a secure base for their dogs (Gácsi et al., 2013; Mariti et al., 2013).

Regarding stranger's stare, results found by Vas and others (2005) seemed to suggest that the attempt to keep eye contact with the dog does not evoke unconditional fear or aggression, whereas other cues of human behavior pattern, like body posture, way of movement and verbal cues, could have an influence on dogs' response. However, as suggested by Line & Voith (1986), staring the dog is a factor that can affect the animal's reaction. For this reason, in our research, the stranger during IA avoided looking the dog in the eye, while in DA he attempted to maintain eye contact.

Data from the holistic evaluation of dogs' responses, stress signals, and behaviors toward strangers seem to show that dogs behave in a more friendly way towards the stranger when approached in an indirect way. DA seems to be more stressful for dogs, likely because it is perceived as more threatening.

As regards to the behaviors towards the owner, no statistically significant difference between the two approaches, analyzing both the whole test and the walking phase, was observed. Instead, a statistically significant difference with regard to the closeness phase, in which the dogs emit longer direct behavior towards the owner in IA compared to the DA, existed. These data might seem discordant with the other results: it would indeed be expected that, being the owner an attachment figure (see Miklósi et al., 2003; Mariti et al., 2013), the dog is more referring to him during the DA, the most stressful situation, and not during a friendlier IA. This result could be explained by interpreting these behaviors expressed towards the owner during AI as a reassurance that the dog gives him in a quiet setting of communication.

More research will be necessary, increasing the number of subjects, especially male that would tend to avoid the physical and visual contact with unknown people (Lore & Heisenberg, 1986).

It would also be useful to include typical family dogs, while the sample used for this study contained a variety of subjects who were particularly used to the contact with strangers, probably because of the training courses they had previously attended.

Finally, an analysis of physiological parameters, such as the heart rate, could be combined with the behavioral data. In particular, the analysis of heart rate variability (HRV and LF / HF) (Bergamasco et al., 2010; Jonckheer-Sheehy et al., 2012) might be relevant.

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## Effetti di differenti modi di approccio umani sul comportamento del cane: risultati preliminari

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*Sintesi*

Lo studio delle reazioni dei cane a diverse modalità di approccio da parte delle persone, gioca un ruolo importante per lo sviluppo della relazione tra uomo e cane.

Lo scopo di questa ricerca è stato quello di sviluppare un protocollo per un test comportamentale al fine di valutare la reazione dei cani a due differenti approcci effettuati da un uomo sconosciuto all'animale.

Venticinque cani di differenti razze e meticci, 17 femmine e 8 maschi, di 56,4±26,2 mesi di età, sono stati sottoposti ad un test comportamentale in cui un uomo sconosciuto approcciava il soggetto, utilizzando due differenti modalità, definite approccio indiretto (IA) ed approccio diretto (DA)

I test erano videofilmati e le reazioni dei cani all'approccio dell'uomo erano analizzati per attribuire i seguenti punteggi: aggressivo (=1), attivo evitante (=2), passivo evitante (=3), ambivalente (=4), neutrale (=5) o amichevole (=6).

Ogni filmato è stato analizzato in modo da rilevare la durata in secondi dei seguenti 11 comportamenti: leccarsi il naso, sollevare la zampa, guaire, chiudere le palpebre e scuotimento del corpo (la loro durata è stata sommata ed usata come misura dello stress del cane); orientamento verso l'estraneo, abbaiare e ringhiare (la loro durata è stata sommata ed usata come una misura dell'attitudine verso la persona sconosciuta); l'orientamento verso il proprietario, l'approccio ed il contatto con il proprietario (la loro durata è stata sommata ed usata come una misura dell'attitudine verso il proprietario). L'analisi statistica è stata compiuta usando il test di Wilcoxon ($p<0,05$) al fine di confrontare le risposte a DA e IA e la durata dei comportamenti durante DA e IA.

I cani hanno risposto in modo più amichevole alla modalità di approccio IA che a quella DA ($Z=-2,049$, $p=0,021$). Per quanto riguarda i segnali di stress, la durata è stata maggiore in DA rispetto a IA, sebbene la differenza non abbia raggiunto un valore statisticamente significativo ($Z=-1,280$, $p=0,201$). L'attitudine verso l'estraneo si è dimostrata diversa ($Z=2,64$, $p=0,008$) in DA rispetto a IA: i cani guardavano all'estraneo, abbaiavano e ringhiavano maggiormente durante DA.

Infine, nessuna differenza statistica è stata osservata nei due diversi approcci per quanto riguarda i comportamenti rivolti al proprietario.

Questi risultati preliminari sembrano mostrare che i cani si comportano in in modo maggiormente amichevole verso un estraneo che si approcci a loro in modo indiretto. DA sembra essere più stressante per i cani, probabilmente perché percepiscono questa modalità di approccio come più pericolosa.

# Is Tellington-touch a relaxation technique for dogs?

Alice Dal Toso*

*Dog trainer freelance*

*Abstract*: The aim of this research was to assess the effectiveness of Tellington-Touch (TT), a massage consisting in a series of circular touches of the hands and fingers intended to reduce stress, as a relaxation technique for dogs, comparing its effect to casual handling. Fourteen dogs (5 males and 9 females; 39.9 ± 27.1 month old) underwent three sessions with an experimenter who was not a recognized t-touch practitioner. The experimental sessions were conducted in the same experimental room, where the dogs were left free to explore the environment for 1 minute and then, for 4 minutes, they were subjected to:

1. a control session (CT): dogs stayed inside the room with the experimenter who did not interact with the animal;
2. casual handling (CA): dogs were stroked on the whole body by the experimenter;
3. TT: as suggested by a recognised Tellington-touch practitioner, dogs were handled using the following 3 t-touches: Ear Slides, Clouded Leopard and Noah's March.

In the 4 minutes which followed, dogs were left free and videoed in order to measure the duration of behavioral signs of stress (circling, scratching the door, self-scratching, whining, lip licking, restlessness, yawning, shaking and barking).

After each session, saliva was taken for cortisol determination.

Statistical analysis revealed no significant difference between the 3 sessions for saliva cortisol. The comparison of behavioral data (sum of duration in seconds of single behaviors) found that the display of signs of stress was higher in CT (67.5 s) compared to both CA (6.5 s; Z=-3.234; p=0.001) and TT (11.0 s; Z=-3.108; p=0.002), but no difference was found between CA and TT (Z=-0.874; p=0.382).

The results of the current research seem to indicate that, regardless of its type, gentle human touches have a positive impact on stressed dogs. However, while short sessions of gentle handling have an immediate relaxing effect in dogs detectable in their behavior, physiological changes may need longer times of handling. These preliminary results suggest that TT, at least when carried out by a person who is not a t-touch practitioner, has a relaxing effect on dogs similar to that of gentle handling.

*Key Words*: Tellington-touch, stress, dog, salivary cortisol.

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## Introduction

Dogs (*Canis lupus familiaris*) have lived with humans for many years and they are able to create a strong attachment bond with the human being (Mariti et al. 2013); many owners pay particular attention to the welfare of their animals and they try to avoid them any stress, although many of them do not have very detailed knowledge on this topic (Mariti et al., 2012). A major aspect of dog well-being seems to originate from direct human-animal interaction and it is well known that gentle physical contact may be an effective means of reducing stress (Hennessy et al., 1997). For this reason, owners whose dogs are anxious or distressed are often advised to gently handle their dogs in order to relax them. Such exercise is sometimes carried out using specific techniques, e.g. Tellington-touch (TT). This emerging technique has been found to relax people in care situations

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(Wendler et al., 2002) and its use is now often suggested also for dogs (Fox, 2004). TT is a series of circular touches of the hands and fingers intended to encourage and increase relaxation, improve athletic ability, introduce a new sense of awareness, enhance healing and reduce stress (Tellington, 1995).

The aim of this research was to assess the effectiveness of TT as a relaxation technique for dogs, comparing its effect to casual handling.

## Subjects, materials and methods

Fourteen dogs (5 males and 9 females; 39.9±27.1 months old) underwent three sessions with an experimenter who was not a recognized t-touch practitioner. Experimenter characteristics were standardized as much as possible: they were 2 girls, from 25 to 30 years old, of medium height and weight (1.60-1.70 m; 50-60 kg), sporty dressed. Each dog was handled by one experimenter and he/she underwent three sessions carried out in a random order to avoid a possible order effect. The experimental sessions, spaced one week apart and always made at the same time of day, were conducted in the same experimental room, where the dogs were left free for 1 minute to explore the environment and then, for 4 minutes, they were subjected to:

1. a control session (CT): dogs stayed within the room with the experimenter who did not interact with the animal;
2. casual handling (CA): dogs were stroked on the whole body by the experimenter;
3. TT: as suggested by a recognised Tellington-touch practinioner, dogs were handled using the 3 following t-touches in this order:

*Ear Slides* - It is done by stroking the ears horizontally, from base to tip, or by making small circles starting at the base and working toward the tip. This TT is usually advised to have a calming effect on a stressed or hyperactive dog.

*Clouded Leopard* - This is the basic touch and all of the other circular touches are variations of it. The fingers are slightly curved and finger pads are used to create the circles on the whole body. The Clouded Leopard is usually advised for anxious dogs.

*Noah's March* - This TT is usually used at the end of sessions, done with a long sweeping motion down the entire length of the body, employing long, slow slides of the fingers and palms, which have to remain flexible and relaxed. Its supposed purpose is to connect all the treated areas.

In the 4 minutes that followed, dogs were left free and videoed in order to measure the duration of behavioural signs of stress (circling, scratching the door, self-scratching, whining, lip licking, restlessness, yawning, shaking and barking).

After each session, saliva was taken for cortisol determination. Saliva was collected with swabs (Salimetrics, State College, PA) gently placed into the cheek pouch of the dog by experimente for approximately 90-120 seconds. Samples were checked for visible contamination with food or blood. After sampling, the swabs were introduced into tubes specifically designed to avoid cortisol sequestration (Salivette; no. 51.1534, Sarstedt, Nümbrecht, Germany), temporarily stored in an iced box before the final storage at -20°C. Before analysis, performed within 15 days, swabs were thawed and centrifuged at room temperature at 1500g for 15 minutes to obtain clear saliva, which was used for cortisol determination using an enzyme immunoassay kit (Salimetrics, State College, PA) (Hekman et al., 2012). Samples were assayed in duplicate, using 25 ml of sample per well. The kit's lower limit of sensitivity was 0.03 ng/ml.

Physiological and behavioral data was compared through Friedman and, when appropriate, through a Wilcoxon test with Bonferroni correction ($p<0.0167$).

## Results

The Friedman test revealed no statistical difference between the 3 sessions for saliva cortisol (Figure 1) (median values in ng/dl: CA 7.26; TT 6.25; CT 6.75; p=0.878).

The comparison of behavioral date (sum of duration in seconds of single behaviors) through the Wilcoxon test (Figure 2) found that the display of signs of stress was higher in CT (67.5 s) compared to both CA (6.5 s; Z=-3.234; p=0.001) and TT (11.0 s; Z=-3.108; p=0.002), but no difference was found between CA and TT (Z=-0.874; p=0.382).

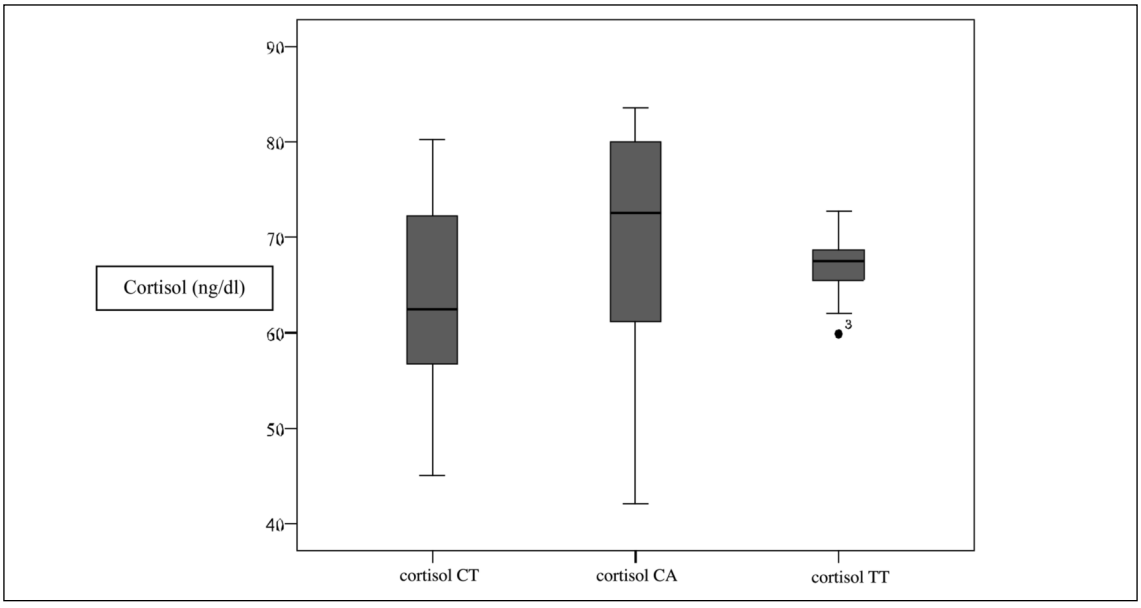


Figure 1. Salivary cortisol (ng/dl) in the CT, CA and TT sessions.

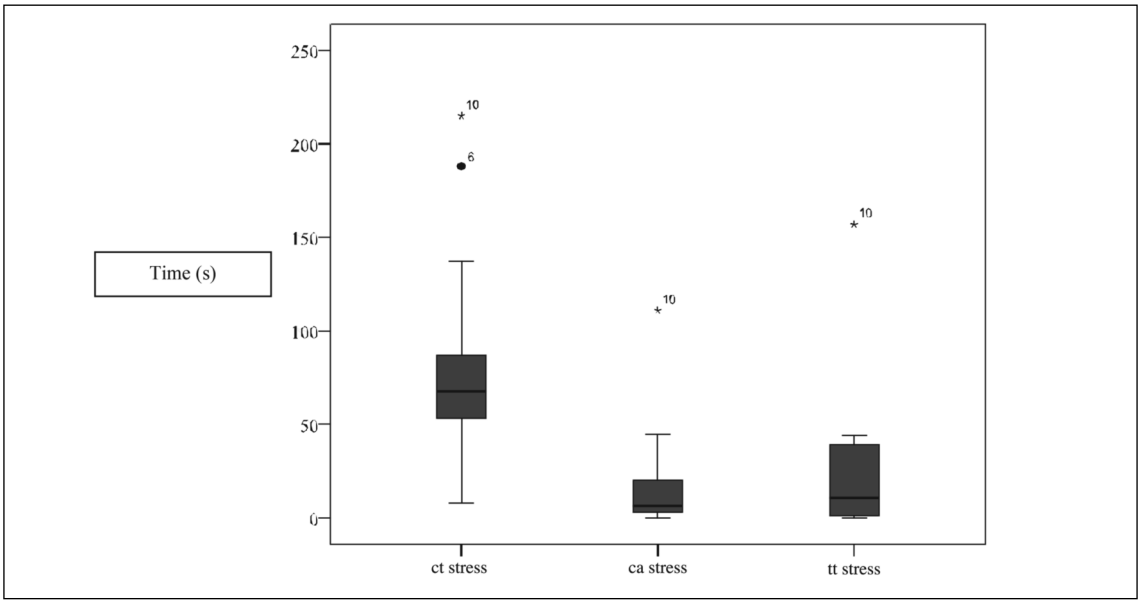


Figure 2. Duration (s) of the signs of stress displayed in the CT, CA and TT sessions.

## Discussion

Many researchers have investigated the positive effect of tactile human-dog contact on the physiology, the mental states and the immune system of humans: petting dogs decreases blood pressure and heart rate (Baun et al., 1984; Vormbrock & Grossberg, 1988) and increases the immune defences (Charnetski et al., 2004).

In human medicine, the use of touches in therapy has been shown to reduce anxiety (Heidt, 1981; Quinn, 1982), systolic blood pressure (Quinn, 1984) and to increase functional capacity (Wendler et al., 2002). Hennessy and colleagues (1998) found that 20 minutes of petting reduced cortisol levels in sheltered dogs and suggest that it may be an effective means of reducing stress in other common aversive situations.

Unlike Hennessy and colleagues (1998), in this study, cortisol levels did not differ between the 3 sessions; such difference of findings can be explained by the fact that physiological changes could be produced by longer sessions of gentle handling. Moreover, salivary cortisol is affected by many variables (Dess et al., 1983) and it has a high degree of individual variation (Coppola et al., 2006), that makes it difficult to find significant differences in a relatively small sample.

Therefore, results of the current research seem to indicate that, regardless of its type, human gentle touches have a positive impact in stressed dogs. However, while short sessions of gentle handling have an immediate relaxing effect in dogs detectable in their behavior, physiological changes may need longer times of handling.

## Conclusion

These preliminary results suggest that TT, at least when carried out by a person who is not a recognized t-touch practitioner, has a relaxing effect on dogs similar to that of gentle handling. Further research is needed to assess whether TT has a higher effect when done by a practitioner, or personalised on the individual dog or carried out for longer time.

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## Il Tellington-touch è una tecnica di massaggio rilassante per i cani?

Alice Dal Toso

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*Sintesi*

Lo scopo della ricerca è stato quello di valutare l'efficacia del Tellignton-touch (TT), una tecnica di massaggio consistente in una serie di tocchi circolari delle dita utilizzata per ridurre lo stress, come tecnica di rilassamento del cane, paragonandola ad un tocco casuale.

Quattordici cani (5 maschi e 9 femmine; 39,9 ± 27,1 mesi di età) sono stati sottoposti a tre sessioni effettuate sempre nella stessa stanza da un ricercatore non qualificato come "t-touch practitioner". I cani erano lasciati liberi per 1 minuto nella stanza per esplorare l'ambiente e quindi, per 4 minuti, erano sottoposti alle seguenti manipolazioni:

1. una sessione di controllo (CT): i cani restavano nella stanza con lo sperimentatore che non interagiva con loro;
2. una manipolazione casuale (CA): i cani erano accarezzati su tutto il corpo dallo sperimentatore;
3. il TT: come suggerito da un riconosciuto Ttouch practitioner, i cani erano manipolati usando tre differenti tecniche: Ear Slides, Leopardo nebuloso e la Marcia di Noè.

Nei seguenti 4 minuti, i cani erano lasciati liberi e videoripresi per misurare la durata dei segni comportamentali di stress (girare in tondo, grattare la porta, grattarsi, guaire, leccarsi il naso, sbadigliare, scuotersi ed abbaiare).

Dopo ogni sessione era prelevata la saliva per la determinazione del cortisolo.

L'analisi statistica non ha rivelato alcuna differenza significativa tra le 3 sessioni per quanto riguarda le concentrazioni di cortisolo. Il confronto tra i dati relativi ai comportamenti di stress (somma della durata in secondi dei singoli comportamenti) ha evidenziato che essi erano più prolungati in CT (67,5 s) in confronto a CA (6,5 s; Z=-3,234; p=0,001) e TT (11,0 s; Z=-3,108; p=0,002) ma nessuna differenza è stata trovata tra CA e TT (Z=-0,874; p=0,382).

I risultati della presente ricerca sembrano indicare che il tocco gentile di una persona, a prescindere dal tipo di tocco, può avere un positivo impatto sul cane stressato. Tuttavia, mentre brevi sessioni di manipolazioni gentili hanno un immediato effetto rilassante sui cani, riscontabile dal loro comportamento, i cambiamenti fisiologici possono richiedere tempi di manipolazione più lunghi.

Questi risultati preliminari suggeriscono che TT, per lo meno quando non è praticato da una persona esperta della tecnica, ha un effetto rilassante nel cane simile a quello di un tocco gentile.

# The semiotic canine: scent processing dogs as research assistants in biomedical and environmental research

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*Abstract*: The use of dogs in biomedical diagnosis, detection and alert as well as for the search and monitoring of species-at-risk is an emerging field of research. Standard practices are converging towards models that are not necessarily consistent with the well established field of (animal) psychophysics. We briefly discuss the different challenges of applied canine olfactory processing and discuss the adoption of more valid and reliable methods. For mostly historical reasons it seems, scent processing dogs are trained and tested using multiple alternative stimuli in choice tasks (e.g., line-ups including 6 alternative choices, or 6AFC). Data from psychophysics suggest that those methods will reduce or at the very least misrepresent the accuracy of canines. Unless canines are an exception to the rule, sensory, perceptual and cognitive arguments (e.g., Gadbois & Reeve, 2014) can be made against most multiple alternative forced choice tasks (mAFC's) in favor of detection tasks (yes/no and go/no-go procedures) or, as a compromise, simpler discrimination tasks (2AFC or 3AFC at most). We encourage the use of Signal Detection Theory as it focusses on two important factors in defining the validity and reliability of scent processing dogs: 1) It is a robust measure of sensitivity, an important factor in both diagnosis and sensory detection, and, 2) It describes the type of errors (false alarms vs. misses) that a given dog is most likely to commit, allowing for a solid assessment of performance and potentially a readjustment in training. We give an example with Diabetes Alert Dogs (DAD's) specialized in Hypoglycemia Detection in vitro and discuss the potential advantages of keeping a low number of alternatives during training and testing, the importance of low saliency training (LST), as well as adopting pure detection tasks requiring a response commitment from the dogs for both "yes" and "no" responses. The value of d' (a detectability or discriminability measure) and bias measures (criterion) are discussed in the context of canine selection, performance assessment and diagnostic accuracy across applications.

*Key Words*: canine olfactory psychophysics; conservation canines; diabetes; hypoglycemia; low saliency training; signal detection theory.

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Dogs serve increasingly important roles in a variety of medical assistance and alert positions. Due to their evolutionary close relationship with humans, dogs are very sensitive to behavioral changes and social cues from humans (Miklosi & Topal, 2013). This fact, combined with proper training, results in dogs that can accurately predict seizures (Brown & Strong, 2011), potentially predict migraines (Dawn & Bhowmick, 2013), and serve as anxiety and Post Traumatic Stress Disorder service dogs (Yount et al., 2013). Recently, researchers have become interested in whether dogs can further assist humans by using their noses to diagnose disease and alert to dangerous medical events. It is well known that dogs have incredibly sensitive noses, and empirical studies have revealed dogs detecting cancers with high levels of sensitivity and specificity (Jezierski et al., 2015). Furthermore, the use of diabetic alert dogs to signal hypoglycemic events is becoming more common. Despite a lack of empirical studies examining how dogs detect hypoglycemia, they appear to be benefitting their owners greatly (for reviews see Gadbois & Reeve, 2014; Wells, 2012). Dogs have also been involved in wildlife conservation research to monitor species-at-risk.

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The field of canine biomedical detection, diagnosis and alert is expanding rapidly. As teams scramble to develop methodologies, a standardization is still lacking (as discussed by Elliker et al., 2014; Jezierski et al., 2015) despite the likelihood that National Health organizations such as the FDA or Health Canada in North America will require strong Standard Operating Procedures and standardized protocols if canines are to be ever accredited as "diagnostic tools". We believe that the choice of training method will depend on the ultimate goal of the task. Currently, in the literature, the same procedures are commonly used during training conditions, testing conditions (to assess the performance of the dog), and actual diagnostic testing and field deployment. In this paper we identify a few problems in the rationale used with the most popular methods. Let us explore each issue one at a time.

## The importance of understanding errors and biases

The stakes are not the same for a mine detection dog (that really cannot afford "misses" or it will pay with its life) and an endangered species search dog (missing a hidden snake during a survey search is unlikely to have dire consequences for the survival of the species or even the local population). Biomedical canines are somewhere in the middle of this spectrum: Detection dogs could be trained to find dangerous bacteria in hospital environments (Bomers et al., 2012), alert to a nocturnal hypoglycemic event with a child that cannot wear a continuous blood glucose monitor (Chen et al., 2000; Wells et al., 2008), or diagnose potential cancers (Jezierski et al., 2015). Those three functions (detect, alert, diagnose) come with different outcomes and corresponding risk assessments, in particular, the cost of making mistakes. The next sections explain what is at stake, how to measure errors and bias, and how to remediate that situation if possible and appropriate.

Not unlike decision theory and diagnostic theory, Signal Detection Theory (SDT) takes into consideration the errors made during judgements. It computes hits (true positives), correct rejections (true negatives) as well as two error types: false alarms (false positives, analogous to type 1 errors in statistics) and misses (false negatives; analogous to type 2 errors in statistics). Most diagnostic toolsets would, from these values, extract sensitivity and specificity scores. SDT goes further: It defines a very robust sensitivity index, d' ("d prime") that can be defined as an index of detectability (in detection tasks) or as an index of discriminability (in a discrimination task). This important distinction calls for a precision: Gadbois & Reeve (2014) distinguish between four psychophysical experimental contexts. We will focus here on the first three, the most likely to be used with scent dog training and assessment. The definitions given below may be slightly oversimplified in the eyes of an animal psychophysicist or sensory neuroscientist, but they cover the essentials of the current trends including one procedural option that we are suggesting. We suggest Kingdom and Prins (2016) or McNicol (2005) for a clear and concise discussion of SDT's parameters. More advanced users of SDT may want to consult Macmillan & Creelman (2005).

We will start with the most cognitive task. Most textbooks (Kingdom & Prins, 2016; Macmillan & Creelman, 2005; McNicol, 2005) discuss identification or recognition tasks. They are typically labelled "matching-to-sample" MTS tasks in the animal literature, and more specifically (implicitly at least) referring to simultaneous MTS (DMTS or delayed matchingto-sample tasks are typically used to specifically study short term memory mechanisms). Technically this task requires the handler to present a sample (standard, sometimes called a "reminder" in cognitive psychology) to the dog (that it will sniff) and then ask the dog to find the match among a number of options, typically 6 in most line-ups, although some will include 8 or 10 choices. Forensic canines (Schoon & Haak, 2009) are the typical example of this approach. As we argued in Gadbois & Reeve (2014), there are issues with this method when the intention is to determine a dog's accuracy. For example, line-ups (6+ choices) add unnecessary perceptual and mnemonic interference (see below for a discussion of interference in multiple choice tasks). In these tasks, every time the dog is asked to

match the standard to one of the choices, the standard (sample) may be different. Sample sets can be very small (even just one odor presented as a cursory reminder) or n>2 with no theoretical limits. Dogs can be presented with 2, 3, 4, … n choices of one target and distractors or blanks. A classic line-up of 6 choices is therefore labelled a 6AFC (6-alternative forced choice). If high performance is expected, perceptual and mnemonic interferences are significant beyond 3 choices. This is supported by classical psychophysics (Kingdom & Prins, 2016; Macmillan & Creelman, 2005; McNicol, 2005).

Likely more common is the case of a straight discrimination between multiple options. The animal is expected to identify a target stimulus from a number of distractors (or blanks in early training). Not unlike the scenario above, the dog must choose a target among multiple choices (2AFC, 3AFC, … mAFC). The difference is that typically there is only one odor to identify, and a reminder (i.e., the sample or standard) is not offered (or necessary). This model works well when a basic perceptual discrimination is desired.

The last model, and also the simplest and potentially the most elegant, is a pure detection task. The information processing assumptions are minimal in the sense that the approach identifies a sensory sensitivity (in fact the d' mentioned above). The approach here is to present the dog with one stimulus and requires a "yes" or "no" answer. For that reason, the model is called Y/N and works within the framework of a go/no-go type of response. Note that this model is the most likely to show a bias in the decision pattern from the dog. But what seems at first like a shortcoming should be considered an advantage. A detection task will allow you to most accurately identify your dogs' response biases. If you are planning to use a 2AFC (or other mAFC procedures like line-ups and carousels) the same biases that would be identified in a detection procedure are likely to emerge. In other words, in order to understand the response bias of your dog, the detection task will give you a clearer picture of the response profile and a great context for remediation considering the simplicity of the procedure.

The Y/N model measures bias and quantifies it as a "criterion". There are different criterion measures found in the literature (see Macmillan & Creelman, 2005 for details) but the basic idea is to categorize a dog along a continuum from a "conservative" to a "liberal" decision maker. Liberal dogs are more likely to give false alarms (and minimize misses) in an attempt to maximize hits. Assuming false alarms are not problematic in the applied context where the dog works (i.e., no negative consequences), this can be a great response profile. It is certainly the one preferred by landmine detection and explosive detection dog handlers. Likewise, a conservative dog will minimize false alarms at the cost of hits, and consequently increase misses.

For now, we will focus on the consequences of knowing this information. Obviously if (and only if) a dog has a bias (and most would, the question would be "how much of a bias" or deviation from what is called in SDT an "ideal observer"), then a trainer can decide if a dog's response profile needs to be modified to change the bias. Modifications can be made by giving feedback on wrong responses, or by changing the reward saliency, frequency, or schedules.

## The potential problem with proportion or percentage correct data as performance

Although SDT applies very well to Y/N and go/no-go detection tasks, it can also be applied to 2AFC and mAFC tasks. It is important to realize that some basic assumptions need to be clarified first, namely, if the responding is biased or unbiased. If the responding is unbiased, proportion correct answers are appropriate and can be transformed into a d' (see Kingdom & Prins, 2016 or Macmillan & Creelman, 2005 for computational details). The problem with assuming an unbiased response profile is that it is likely not realistic. If bias occurs, then using proportion correct as a measure of psychophysical accuracy "becomes an invalid measure of sensitivity" (Kingdom & Prins, 2016, page 161). As mentioned above, an even more fundamental issue arises: although

2AFC tasks are typically easier than Y/N tasks, mAFC tasks tend to be more challenging, with the potential exception of 3AFC tasks (Gadbois & Reeve, 2014; Macmillan & Creelman, 2005; McNicol, 2005). This can be explained fairly easily by pointing out that both sensory-perceptual and mnemonic (working memory) interference can and will occur as the number of choices presented increases. The mnemonic argument was made in Gadbois & Reeve (2014), but in the case presented there, the working memory load was significant considering that a sample set of 8 stimuli was presented (to be matched to a target in a 6AFC line-up). In most cases when one odor is presented as the sample (or standard), the main interference to worry about is sensory: when dogs sample each odor station in a line-up or carousel, there is a possible sensory interference, not excluding sensory memory especially when the stimuli are of low saliency or if they are very similar (suggesting a low d' value).

## Other considerations

We will quickly address a few points before presenting an example based on ongoing research in the Canid Behaviour Research Lab at Dalhousie University. First we would like to point out that SDT is a complex area of psychophysics, sensory psychology and neuroscience and many of the important points could not be expanded upon here (see above for primers and handbook references). The computational aspect of the theory is not very complicated, but requires more space than what is allotted here to cover adequately. One issue that we will mention is the existence of non-parametric models of SDT. Although there are debates about the necessity to apply non-parametric models when they seem to be the most appropriate, some authors argue that the standard SDT theory approximates well enough non-parametric data (see Pastore et al., 2003 for a discussion). Second, the core of the issue lies in the goals of the experimenters, trainers and diagnosticians. Note that when dogs are trained for alert, the most ecologically valid task (including in training) is the detection model. Fundamentally, alert dogs need to signal the presence of the target (e.g., hypoglycemia detection dogs alert to hypoglycemia) and not respond to the absence of the target. This is a typical go/no-go situation and is closer to the Y/N decision task (except that the "no" in the go/no-go task requires no response or the inhibition or a response). In other words, alert dogs do not have an array of stimuli to "compare and contrast". They simply need to alert when the target is present, and inhibit a response when it is not (although, in assessing bias and d', you may want to consider committing the dog to a "yes" response (e.g., nose pointing the target for 5 seconds) and to a "no" response (e.g., sitting back in front the stimulus station). In other cases, it is quite possible that dogs would need to discriminate between similar stimuli that co-occur temporally and spatially. Different strains of a bacteria or parasites to detect may be examples, or as we experienced with our wildlife conservation canines, many occurring species of snakes, with only one being the main target (see Gadbois & Reeve, 2014, for the snake example).

## Practical example

In Dalhousie's Canid Behaviour Research Lab, we have developed a training program that allows us to train dogs with no previous sniffer training to detect and discriminate between low saliency odors; specifically, human breath samples. What follows is a brief summary of this training program, and how it was applied in our study aimed at determining whether dogs could detect hypoglycemia in vitro, using breath samples from individuals with Type 1 Diabetes.

An important point to note is that we select our dogs very carefully. We select for dogs that are highly motivated, and that have a very high working drive. As a result, our studies (and most studies of biomedical detection with dogs) test between 3 and 5 dogs. Although this may seem like a

small number of dogs with which to complete an empirical study, we are not attempting to provide evidence that all dogs are capable of doing biomedical scent detection work, but rather that a few, very carefully selected dogs can be trained to be successful.

The first phase of the training program is Low Saliency Training (LST). Here, we train our dogs to detect Orange Pekoe tea that has been steeped for 5 minutes, and then gradually decrease the saliency of the tea over time by steeping it for less time, and by diluting it with water. Using a 3AFC procedure (with a reminder), a tea stimulus is presented with two other water stimuli that serve as controls, and the dogs are required to indicate which sample is the tea sample.

If a dog demonstrates the ability to detect the tea stimulus consistently and reliably, the saliency of the tea stimulus is decreased gradually over a series of predetermined saliency levels. Once training with the liquid tea stimuli is completed, we then bridge the gap between tea and breath samples by holding tea in our mouths for 30 seconds, spitting it out, and then breathing through a breath collection tube containing a cotton ball; thus creating a "tea breath" sample. Breath samples are presented against blank cotton ball controls. Once a dog demonstrates the ability to detect the tea breath sample, they are then presented with a clean breath sample. If a dog can detect a clean breath sample successfully, the LST is complete and the dog can now detect human breath.

We find the LST phase important for two reasons: 1. It counters any potential familiarity effects by teaching the dogs to pay attention to stimuli that they have likely ignored most of their lives (human breath), and 2. The LST training serves as an inclusion test by showing us whether a particular dog is capable of detecting low saliency stimuli. If a dog cannot complete the LST successfully, we do not proceed with further training.

After completing the LST we then train the dogs to discriminate between multiple breath samples; first between breath samples from three different individuals, and then between three breath samples donated by one individual at three different times of the day. Again, this phase of training demonstrates to us that a dog is capable of discriminating between competing stimuli and that they are ready to be tested using specific medical samples. Four volunteer dogs, Nutella, Koda, Bella, and Mist, successfully completed this training program. When we presented the dogs with breath samples donated by individuals with Type 1 Diabetes, we first tested their ability to discriminate between three different breath samples obtained from one individual by presenting them with three breath samples simultaneously: one when the blood sugar of the breath donor was hypoglycemic, one when it was normal, and one when it was hyperglycemic, and requiring that the dog identify the hypoglycemic breath sample. We tested their ability to do this with sample sets from three different individuals. All four of the dogs tested were able to discriminate between the samples with average accuracy rates between 90% and 100%.

We then trained Nutella and Koda to detect hypoglycemia by presenting them with low, normal, and high samples from one individual sequentially (one sample at a time). Here, the dogs were trained to smell a single sample and indicate whether "yes" this is a hypoglycemic sample, or "no" this is not a hypoglycemic sample. Once they demonstrated the ability to detect the hypoglycemic sample within a sample set, we then added a second sample set (a second hypoglycemic breath sample, a second normal breath sample, and a second hyperglycemic breath sample) from the same individual, and tested whether Nutella and Koda could generalize the odor of hypoglycemia to the second sample set; that is, say "yes" to both low breath samples and "no" to all other samples. Presenting the samples in this way allowed us to test whether the dogs could identify multiple instances of hypoglycemia occurring in one individual. As illustrated by the data in Table 1, Nutella was capable of generalizing the odor of low blood sugar to the new breath sample. Koda, however, was not, as illustrated by his low sensitivity score. Although Koda continued to signal "yes" to the first low blood sugar breath sample, he never signaled "yes" to the second low blood sugar breath sample from the same individual.

Table 1. Nutella and Koda's performance on a test of their ability to generalize the odor of hypoglycemia across two breath samples from one individual, using a Go/No-Go procedure.

| | **Nutella** | **Koda** |
|---|---|---|
| d' | 1.675 | 1.468 |
| C | 0.313 | 0.911 |
| Sensitivity | 70% | 43% |
| Specificity | 88% | 95% |
| Accuracy | 78.7% | 69% |
| Precision | 84.8% | 89% |
| No. of trials | 160 | 120 |

As illustrated by the dogs' performance across the two sample presentation methods, presenting the stimuli to the dogs using both 3AFC and Y/N presentation procedures allows for a more thorough understanding of their abilities. Although both Nutella and Koda were able to discriminate between samples successfully (both averaged 100% accuracy), when tested on their ability to detect (Y/N) low blood sugar samples, only Nutella continued to be successful. The "C" in Table 1 represents the criterion (one of the few measures of bias). A positive C indicates a conservative decision maker. The values are from -1 (very liberal) to +1 (very conservative). Both dogs are conservative, but Nutella is the closest to the "Ideal Observer" (meaning that she maximized both correct rejections and hits). Note that Koda has very high specificity. This means that he is accurate at indicating what is not a hypoglycemic sample (maximizing correct rejections) but poor at identifying what is a hypoglycemic sample (he committed more misses).

## Conclusion

When assessing the ability of dogs to diagnose, detect or alert, clear context-appropriate goals need to set before considering a training and assessment protocol. If the goal is to obtain an accurate diagnosis, then procedures resulting in high accuracy (Y/N) and a clear description of the errors and bias need to be adopted (SDT). Even if perfect or closeto-perfect accuracy is not essential, a procedure that can identify error types is still very informative and can influence training or help in selecting "top performance" dogs. Multiple choice procedures such as line-ups increase the sensory and mnemonic interference of the task while reducing performance (percentage correct scores) which may be appropriate during training, but fail to give an accurate profile of the performance of the dog.

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## La semiotica canina: i cani per la ricerca olfattiva come assistenti nella ricerca biomedica ed ambientale

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*Sintesi*

L'utilizzo dei cani nelle diagnosi cliniche e nella ricerca e monitoraggio di specie a rischio, è un campo emergente di ricerca.

Le procedure standard convergono verso modelli che non sono necessariamente in sintonia con il campo della psicofisica animale. In questa review saranno descritti i problemi relative alla ricerca olfattiva e l'adozione di metodi validi.

Per ragioni storiche, i cani sono addestrati utilizzando stimoli multipli in test di scelta (ad esempio stimoli in fila che includono 6 scelte alternative, 6AFC).

I risultati di ricerche psicofisiche suggeriscono che questi metodi riducono l'accuratezza del cane. a meno che i cani non costituiscano un'eccezione alla regola, prove sensoriali, percettive e cognitive possono essere addotte contro i test di scelta multipli (mAFC) in favore di prove di rilevamento (sì/no) o prove di discriminazione più semplici (2-3 stimoli).

Gli autori incoraggiano ad usare la Teoria di rilevamento dei segnali poichè si basa su due importanti fattori nel definire la validità e affidabilità del cane da ricerca olfattiva:

1) è una misura robusta della sensibilità, un fattore importante nella diagnosi e nel rilevamento sensoriale;
2) descrive i tipi di errore (falsi allarmi vs mancate segnalazioni) che un cane può commettere, permettendo un'accurata valutazione della performance e potenzialmente una modificazione del percorso di addestramento.

Sarà fornito un esempio di ciò descrivendo l'addestramento dei cani per l'allerta diabete (DAD) specializzati nel rilevamento dell'ipoglicemia. Sarà discusso il potenziale vantaggio di mantenere ridotto il numero di stimoli alternativi durante l'addestramento e di un training con stimoli poco salienti.

# Aggressive behavior in a cocker spaniel

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*Abstract*: A fawn cocker spaniel, male, 2 years old, was subjected to behavioral counseling as he presented aggression towards owners and other dogs, especially male.

According to the French school, the symptoms presented by the subject can be traced back to a form of sociopathy with the presence of a strong disturbance of intra- and inter-specific communication.

Given the episodes of biting, therapy with Clomipramine (2 mg/kg/ q12h) for 5 months was established, in addition to 2 months necessary for weaning from the medication. The use of Dog Appeasing Pheromone, with collar worn for 6 months was prescribed.

The behavioral modification therapy initially focused on the proper management of resources by providing adequate information to owners about it.

Aggression is one of the most frequently reported behavioral problems referred to veterinary behaviorist and requires careful management for the serious physical and psychological consequences that may result in bites. If the first effort of the veterinarian should be to ensure the safety of people who are in contact with the dog, the protection of animal welfare is not less important. In fact, a dog presenting an aggressive behavior towards co-specifics or, especially, towards the owner, must receive careful clinical and behavioral assessment to identify the cause, accompanied by a thorough risk analysis.

An urgent action is therefore necessary to ensure the welfare and to prevent any worsening of symptoms resulting in exclusion from the family. In fact, an aggressive dog will often be confined in small spaces and can not share with the owner many opportunities for social life. Immediate action is also requested by the instrumentalisation of the aggressive behavior that is very frequent and dangerous.

*Key Words*: dog, aggression, clomipramine

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## Presentation

A fawn cocker spaniel, male, 2 years old, was subjected to behavioral counseling as he presented aggression towards owners and other dogs, especially male.

## History and presenting signs

The dog was adopted at one month of age from a private breeder. The animal lives in the apartment and is owned by a couple without children; both owners work and the dog spends long periods, alone, in the house. The animal is mainly managed by the male owner toward whom he shows a greater deference than the woman; the dog responds to the call, obeys commands and goes out for eliminations 3 times a day.

Initially, the dog had a peaceful relationship even with the woman but it was disrupted by the

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increasingly frequent occurrence of aggressive behavior. The woman reports that the fear of a possible bite makes her unable to be affective towards the dog.

When there are guests, except for a few relatives of the owners, the dog is confined to a room, to prevent possible aggression. He is confined to the kitchen also when he is left alone at home, to limit destruction and urinary markings.

The owners report describes the dog's behavior towards them as "authoritarian and aggressive," characterized by frequent bites with a gradual onset of unpleasant behaviors: asking for food from the table, growling during the play, going up on beds and sofas, barking insistently at strangers at the door.

If the owner tries to pet the dog, the animal can show aggressive behavior; on the contrary the dog is quieter when he starts the interaction with the owner.

The dog is punished by the owner when he growls or shows aggressive behavior. The punishments are prolonged even if the animal emits signals related to avoidance, pacification and submission.

Food and water consumption are normal: the dog is fed twice a day with industrial food.

The exploratory and somesthestic behaviors are also normal.

Eliminations are normal, with the exception of those that the dog makes when left for a long time alone at home.

Regarding sexual behavior, the dog does not mount objects or people. Being the dog a fine specimen from a morphological point of view, he has been mated several times.

Sleeping behavior is normal.

The dog plays with the owner but he tends to get irritated, if the contact is too long, and to become aggressive. Social behavior is characterized by intraspecific aggression towards strange dogs, especially if male.

## Physical and laboratory evaluation

The clinical examination did not reveal any kind of alteration. Laboratory tests performed to assess liver and kidney functionality were normal.

## Diagnosis

According to the French school, the symptoms presented by the subject can be traced back to a form of sociopathy with the presence of a strong disturbance of intra and inter-specific communication.

The animal does not present all aspects of sociopathy as the owners requested a behavioral counseling at the early signs of aggression with bite. The symptoms worsened at puberty and further at social maturity. The management of the different resources has become more problematic because the punishments inflicted by the owners and the misinterpretation of submissive postures and communication signals of the dog. These facts may have created anxiety in the patient showing signs of aggression by irritation during any approach.

## Treatment

Given the episodes of biting, therapy with Clomipramine (2 mg/kg q12h) for 5 months was established, in addition to 2 months necessary for weaning from the medication. The use of Dog Appeasing Pheromone, with collar worn for 6 months, was prescribed.

The behavioral modification therapy initially focused on the proper management of resources by providing adequate information to owners about it.

Canine ethology notions were also provided to the owners, especially with regard to communication and to the calming signals.

An extensive explanation of the negative factors arising from the punishments was given to the owner, advising against the use of them and recommending positive reinforcement.

The owners were taught how to teach the dog some simple traning exercises (sit, down and stay) that are required to increase the animal's initiative control, especially in particular circumstances such as the entry of people in the house.

A desensitization and counter conditioning program was also set to reduce aggressive behavior towards family people and strangers alike.

The play of the owners with the dog was changed, suggesting the practice of obedience and olfactory research exercises.

More frequent walks in a quiet place and little frequented by other dogs were also recommended. The dog proved a great learning ability and a high propensity to collaborate.

## Follow-up

In the five months in which the dog was under drug therapy, two follow-ups were made: the first after 2 months and the second at the fifth month, when it was decided, in view of the improvement of the dog, to start the drug weaning. In both cases, the owners said they had noticed significant improvements in dog behavior and they were reluctant to interrupt drug therapy, fearing a recurrence of symptoms.

A third follow-up was carried out six months after the first visit, in the period of weaning and the owners did not reported any particular event.

A fourth follow-up was carried out five months after drug interruption. The owners reported two more episodes of aggression but of reduced and no bites entities. The dog, in fact, continues to be aggressive towards male dogs and to manifest some aggressive behaviors against unknown persons who visit the house but, given the considerable improvement, the owners expressed a high level of satisfaction.

## Discussion

Aggression is one of the behavioral problems more often referred to veterinary behaviorist and requires careful management for the serious physical and psychological consequences that may result in bites. If the first effort of the veterinarian should be to ensure the safety of people who are in contact with the dog, the protection of animal welfare is not less important. In fact, a dog presenting an aggressive behavior towards co-specifics or, especially, towards the owner, must receive careful clinical and behavioral assessment to identify the cause, accompanied by a scrupulous risk analysis.

Aggression manifestation in an animal as the dog, able to develop a strong attachment bond with the person (Mariti et al, 2013a and b), in fact reveals an alteration of social behavior that often can cause a state of anxiety or fear. Urgent action is therefore necessary to ensure the welfare and to prevent any worsening of symptoms resulting in exclusion from the family. In fact, an aggressive dog will often be confined in small spaces and can not share with the owner many opportunities for social life (Pageat, 1999).

Immediate action is also requested by the instrumentalisation of the aggressive behavior (Mege, 2006). The instrumentalisation process is defined as a modification of the phases that characterize

normal behavioral sequence (appetitive, consummatory and refractory phases). This process, though generalizable to all behavioral manifestations and sometimes deliberately induced by man, is quickly established in aggressive behavior. An instrumentalised behavior is a simplified and automated response: the dog, for example, bites (consummatory phase) without warning signals (appetitive phase).

Underlying the process of instrumentalisation there is an operant conditioning learning that a particular behavior produces a positive result for the animal. In the aggressive behavior, refractory phase disappears first and then the behavior is simplified with the disappearance of the appetitive one.

Positive punishments can induce rapid instrumentalisation of aggressive behavior, as occurred in the present case report, as they can arouse a state of fear from which the animal learns to escape with aggression.

Erroneous and inconsistent management of resources, that prevents the animal to learn the behavior necessary to obtain them, often causes the use of positive punishment. The unpredictability by the dog of the owner's behavior causes attempts, unsuccessful and subject to punishment, to get the resources.

The owner often does not know the canine ethology bases and ignores the existence of calming signals that the dog emits especially when in a stressful situation. The owner then, failing to recognize the calming signals emitted by the animal prior to the assault, punishes him with extended punishments, interrupted only when the dog reacts with aggressive behavior. It is then that the instrumentalisation starts to occur: the aggressive behavior is, in fact, reinforced because, with it, the dog gets the desired result, namely the interruption of punishment.

Acquired this learning, the selection by the dog of the most effective aggression behavioral patterns, can be very rapid, motivated by fear and anxiety in the relationship with the owner.

A reconfiguration of the dog-owner relationship, with a proper resource management, helps to make the animal's daily routine predictable, reducing the anxiety that can result from this uncertainty. Moreover, in this way the owner provides the animal with a number of alternative behaviors that may be successfully used to obtain the desired resources, preventing aggression.

In these cases, to restore the correct behavioral sequence, to reduce the impulsivity and, consequently, prevent further bites, it is often necessary to use a specific drug therapy. In addition to the positive effect on the dog, the prescription of a psychotropic drug often increases compliance of the owners who are so motivated to collaborate.

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# Aggressività in un cocker spaniel

Sabrina Casagrande

*Veterinario esperto in comportamento*

*Sintesi*

Un cocker spaniel fulvo, maschio di 2 anni di età, è stato condotto alla consulenza comportamentale per episodi di aggressività nei confronti dei proprietari e di altri cani, soprattutto di sesso maschile

Secondo la scuola francese, i sintomi presentati dal soggetto possono essere ricondotti ad una forma di sociopatia con la presenza di un forte disturbo della comunicazione intra ed inter specifica.

Considerati gli episodi aggressivi, è stata istituita una terapia con Clomipramina (2mg/kg/die) per 5 mesi, oltre a 2 mesi necessari per lo svezzamento del farmaco. È stato inoltre prescritto il DAP collare per 6 mesi.

La terapia di modificazione comportamentale inizialmente fu mirata a fornire adeguate informazioni ai proprietari relativamente ad una corretta gestione delle risorse.

L'aggressività è uno dei problemi comportamentali più frequentemente riferiti al veterinario esperto in comportamento e richiede una attenta gestione per le serie conseguenze fisiche e psicologiche che possono derivare da una morsicatura.

Se il primo pensiero del veterinario deve essere quello di salvaguardare la sicurezza delle persone che sono in contatto con il cane, non meno importante è la tutela del benessere animale.

Infatti, un cane che presenti un comportamento aggressive verso co-specifici o, specialmente, verso il proprietario, deve essere sottoposto ad un'attenta valutazione clinica e comportamentale per identificarne le cause, insieme ad una analisi del rischio.

Un intervento urgente è quindi necessario per tutelare il benessere e prevenire ogni peggioramento dei sintomi che possono risultare in un'esclusione dalla famiglia.

Infatti, un cane aggressivo sarà spesso confinato in spazi ristretti e non potrà condividere con il proprietario molte delle occasioni di vita sociale. Un intervento immediato, inoltre, è reso necessario anche dal processo di strumentalizzazione del comportamento aggressivo, evento molto frequente e pericoloso.

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