Evaluating the temperament in shelter dogs

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Summary

Seventy-four healthy mixed-breed dogs were studied collecting behavioural data by means of 'focal animal sampling' and 'all occurrences' methods; the ethogram utilised consisted of more than 100 behavioural patterns. All dogs were taken outside the shelter for a walk to analyse their reaction to a novel environment. In addition, three faecal samples were collected from each dog on three consecutive days during daily routine, to measure the levels of cortisol metabolites (CM) to evaluate adrenocortical activity. A Principal Component Analysis (PCA) identified five primary factors: 'subordination/aggressiveness', 'intraspecific dominance-activity', 'anxiety-sociability towards dogs', 'playfulness' and 'sociability towards humans'. Dogs that showed a confident-independent temperament in a familiar context (within the shelter), showed fear in novel situations (outside the shelter). Despite the absence of a proper control we hypothesise that the stress levels were low both behaviourally and physiologically: neither stereotypies nor inactivity and lack of interest in the surrounding environment was observed, and the median CM concentration was moderately low. Lower concentrations of faecal CM were recorded in dogs with a temperament 'sociable to human beings' which were also associated with a longer stay in the shelter.

Keywords: temperament, dogs, public shelter, faecal cortisol, metabolites.

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Introduction

Dog shelters are common in western societies and provide a valuable service by housing stray dogs, dogs brought in by their owners for various reasons, and dogs seized by shelters because of neglect or other violations. Furthermore, the service provided includes seeking subsequent adoption for the dogs. Nevertheless, the literature on shelter dog behaviour is not abundant. The studies available mainly aim at finding behavioural parameters to assess acute and chronic stress in dogs, given the current growing interest in the welfare of domestic animals (Tuber et al., 1996; Beerda et al., 1997, 1998, 1999a, b, 2000; Hennessy et al., 1997, 1998, 2001, 2002a, 2002b). Although the number of studies aimed at explaining behavioural individuality is steadily increasing there have been few attempts to study 'temperament' in shelter dogs. In human research, temperament has been defined as the inherited, early appearing tendencies that continue throughout life and serve as the foundation for personality (Gosling, 2001). Although there is no general agreement on that definition among animal researchers, some of whom prefer the term 'personality' (see for example Svartberg et al., 2005 vs Serpell & Hsu, 2001), it is widely recognised that within vertebrate species, individuals vary along an axis, the extremes of which are represented by individuals defined as 'bold' and 'shy' (Wilson et al., 1994) or 'proactive' and 'reactive' (Koolhaas et al., 1999). Proactive individuals tend to be quicker than reactive ones to explore, and try to manipulate the situation (Koolhaas et al., 1999) even in a novel context. Conversely, they are more prone to forming routines and being less innovative. On the other hand, reactive individuals are more cautious and more sensitive to external stimuli, which they analyse while trying to adjust to the situation. They are slower in taking decisions and, rather than manipulating the situation, they tend to adjust to it in a more passive way (Koolhaas et al., 1999; Sih et al., 2004; Groothuis & Carere, 2005). Moreover, there are clear predictions about the relationship between temperament assessment and the stress response assessed by hypothalamicpituitary-adrenal (HPA) (re)activity: so far, most studies found that shy, reactive, slow and neophobic individuals display a higher HPA reactivity than bold, proactive, fast and neophilic individuals (e.g., Koolhaas et al., 1999; Carere et al., 2005; Cavigelli & McClintock, 2003; Veenema et al., 2003).

According to Svartberg & Forkman (2002), the studies available on temperament assessment of dogs are based on subjective ratings of individual

behaviour and/or on dog breeds (reviewed in Gosling & John, 1999, see also Goddard & Beilharz, 1984, 1985). Ratings, especially by owners, may be biased by a subjective evaluation.

Svartberg & Forkman (2002) carried out a detailed study on personality traits in domestic dogs, on a sample as big as 15.329 dogs from 164 breeds. Their behavioural description was based on standardised tests that, on the one hand are fundamental to allow reproducibility of scientific studies but on the other hand consists of ratings based on observed behaviours rather than of records of frequency and duration of single behavioural patterns, as required by consolidated ethological methodology. The choice to utilise 'rating' or other methods based on behavioural observations to assess personality of animals has been already discussed (Gosling, 2001) and one method is not considered better than the other. We chose to quantify behaviours on the basis of direct observations of the dogs since we thought that rating the behaviour of animals living in a shelter might bias the results, the more so as little or nothing is known about their origin that is, anyway, quite inhomogeneous – stray or pets.

Temperament assessment of shelter dogs is crucial for improving the results of adoption, i.e., when people take a dog from the shelter to their own home as a pet. Behavioural problems, like excessive aggressivity, anxiety, fear, property destruction and so on, are common amongs dogs adopted from animal shelters (Voith & Borchelt, 1996), and this exposes the dogs to the risk of being abandoned once again (Miller et al., 1996). In fact, previous studies demonstrate that behavioural tests carried out on shelter dogs can shed some light on behavioural problems after adoption (van der Borg et al., 1991). Hennessy et al. (2001) pointed out that there is a close relation between behaviour (measured through behavioural tests), plasma cortisol levels and behavioural problems after adoption. In a shelter, dogs are exposed to a high level of novelty and noise; they suffer from separation from previously familar objects; the environment becomes unpredictable and uncontrollable. These are stressors to which all dogs entering in a shelter are exposed, and that are known to activate the hypothalamic-pituitary-adrenal (HPA) axis (Beerda et al., 1999a, b; Hennessy et al., 2001). Temperament and physiological profile assessment of dogs placed for adoption in a shelter, would be of value for the management of the shelter itself because it allows predictions about the (re)activity of dogs in the new environment and, at the same time, makes it possible to alert the future owner on the characteristics of

the dog he is going to adopt. This would lower the probability of impending relinquishment to the shelter.

The present study aims at characterising the temperament of dogs living in a public shelter using standard ethological techniques, as attempted on some species of non-human primates (chimpanzee (*Pan troglodytes*) van Hooff, 1973; Anestis, 2005; olive baboons (*Papio anubis*), Sapolsky & Ray, 1989; bonobos (*Pan paniscus*), de Lathouwers & van Elsacker, 2004), matched with some simple behavioural tests suitable for shelter dogs.

In addition to the behavioural characterisation, we measured cortisol metabolites (CM) in fresh faecal samples. The measurement of faecal CM is an established non-invasive method for evaluating adrenocortical activity in dogs (Palme et al., 2001; Schatz & Palme, 2001). It is perfectly suitable for a situation such as a dog shelter, where the manipulation of animals in even a very gentle way (e.g., in order to collect saliva) could cause a stress reaction itself.

Materials and methods

Animals and housing

The subjects of this study were 74 mixed-breed dogs (40 male and 34 female), selected among a pool of 180-200 dogs regularly housed in the shelter described below, on the basis of length of stay in the shelter (2-12 months), age (1-6 years) and health conditions (unhealthy animals were excluded). The 74 subjects included strays, dogs left by the owners that did not want them anymore and dogs seized by shelter staff due to owner abuse. Dogs were residents in a Public Shelter and Veterinary Hospital called Porta Portese, in Rome. This is a long-standing dog shelter, built at the beginning of the 20th century to house dogs for not more than three days because, for the prevention of rabies, the Italian Law ordered that the animals had to be killed three days after capture (D.P.R. No. 320 of 1954, Rule of Police Veterinary Service). From 1988 in Lazio Region (Regional Law No. 63 of 1988, modified from Law No. 34 of 1997) and from 1991 in all Italy (National Law No. 281 of 1991), dogs are never euthanised unless they are ill or proved dangerous. The result of the 'no-kill' policy is that, in such old shelters like the one described above, some dogs are kept in pairs in a very narrow box for their whole life.

Given that, due to the laws mentioned above all dogs kept in a shelter and/or adopted have to be sterilised, all the subjects of this study were gonadectomized at least one month before the beginning of the observations, to give them the time to recover from the surgery and in order to avoid any bias in the results (Beaver, 1983; Maarschalkerweerd et al., 1997).

The dogs were housed in pairs in boxes (2×2 m) with half indoor and half outdoor zones. The animals were fed and cleaned twice a day by volunteers (around 7.30 a.m. and 3.00 p.m.). During their stay in the shelter the dogs were taken out of the boxes for a walk in fenced areas within the shelter. Each dog was identified and described in an individual file that reported: roll-number, colour, breed, date of arrival in the shelter and, if possible, the dog's previous history.

Behavioural observations

Data were collected using the focal animal sampling method (Altmann, 1974). The observations were made using a check sheet recording all occurrences (Altmann, 1974) of the selected behaviour patterns of one dog (the focal animal) by means of an ethogram that consisted of 110 (in the box), 115 (open fenced area within the shelter) and 25 (interactive session in the open space) behaviour patterns (Appendix 1). The ethogram used in this research was based on the description of dog behaviour (van der Borg et al., 1991; Weiss & Greenberg, 1997; Beerda et al., 1998, 1999a) and on the behaviour of other species (Feaver et al., 1986; Gosling, 1998; Gosling & Bonnenburg, 1998; Gosling & John, 1999).

Each subject was observed in three different situations: 1. inside the box, always with another dog (who lived permanently with the observed dog), for three sessions of observation on different days (30 min/session); 2. in an open space within the shelter for two sessions of observation (30 min/session). During these sessions the dogs were alone with the observer who never interacted with them; 3. in an open space inside the shelter for two sessions of observation, during which behaviour tests were carried out that involved the observer and one dog in the open fenced area. The purpose was to test the independence of dogs from human beings.

The procedure consisted of 10 recordings (5 on two different days, because 10 consecutive trials might cause habituation, biasing dog response) of the reaction of the animals when: a. left alone with the observer moving

around and walking away while the dog was looking at her and b. while the dog was not looking at her; c. the observer crouching without calling the dog and, d. crouching and calling the dog; e. inviting the dog to play; f. stopping play suddenly; g. attempting to cuddle the dog; h. commanding the dog to sit. Out of 10 possibilities, dog response was considered as a score indicating dependence when: a. the dog followed the observer while the latter walked away and the dog *was looking* at her; b. the dog followed the observer while the latter walked away and the dog *was not looking* at her; c. the dog approached the observer when she crouched *without calling* it; d. the dog approached the observer when she crouched *calling* it; e. the dog played with the observer when invited by her; f. the dog invited the observer to continue playing when she suddenly gave up playing; g. the dog accepted being cuddled; h. the dog responded to the command to sit. The opposite of a-h indicated independence.

Furthermore, all dogs were taken outside the shelter for a walk, twice on two different days, for a qualitative evaluation of fear reaction (fleeing, trembling, panic) toward a novel environment, e.g. traffic, unknown people, or unknown noises (Serpell & Hsu, 2001; Svartberg, in press). The behaviour of the animals was observed for 30 min., after which the observer rated each dog in relation to fearful behaviour, to assign the individual to one of 5 classes: (1) very calm (walks without hesitation even in presence of noise and unknown people; explores the environment; urinates with raised leg; defecates; scratches the ground with the hind legs after having urinated or defecated). (2) calm (the same as class 1 but with body, head and tail postures that denote alertness). (3) timorous (walks with some hesitation and explores the environment looking frequently at the observer and asking for reassurance; does not urinate or defecate). (4) fearful (willing to go out of the shelter but tries to flee and trembles when faced by the novel environment, traffic, unknown people, or unknown noises). (5) very fearful (reticent to go out of the shelter, tries to flee, trembles, panics in the novel environment, traffic, unknown people, or unknown noises). Each item was graded from 1 to 3, where 1 represented the minimum and 3 represented the maximum expression in a class for that individual.

In summary, each dog was observed for a total of nine sessions (about 4.5 hours) in different situations that were spread over a maximum of 10 days. On the whole the dogs were observed for 337 hours.

Faecal sampling and determination of cortisol metabolites

Three faecal samples were collected from each dog on three consecutive days (Reid et al., 1984) to measure the levels of CM (Schatz & Palme, 2001), in order to have an indication of inter-individual variation in reactivity to the stressfulness of the shelter environment (Tuber et al., 1996; Beerda et al., 1997, 1998, 2000; Hennessy et al., 1997, 2001; Sousa & Ziegler, 1998; Whitten et al., 1998; Cavigelli, 1999; Matsumuro et al., 1999). Samples were taken between 1:00 and 3:00 p.m., as late as possible but before the second box cleaning of the day. Faecal sample collections were done before the dogs were taken outside the shelter for a walk.

Faeces were frozen within one hour of emission. Portions of 0.5 g of homogenised wet faeces from each sample were extracted with 80% methanol (5 ml) as described previously (Schatz & Palme, 2001) and aliquots of the supernatant were measured in a cortisol enzyme immunoassay (EIA; intra- and interassay coefficient of variation of pool samples: 8.9 and 11.1%; Schatz & Palme, 2001).

Data analysis

Behavioural data were grouped in 16 categories (Table 1) (see also Beerda et al., 1998, 1999a). The temperament of dogs was determined by a normed Principal Component Analysis (PCA) that described the relationship between the individual dogs and the 16 behavioural categories listed in Table 1. PCA can be considered from two viewpoints. First, the analysis transforms the original correlated variables into another set of uncorrelated variables of decreasing variances (the eigen values). This makes reduction of the number of variables possible while retaining as much variability in the data as possible. Second, the analysis transforms the information on dogs into individual scores, optimising the variances in the same manner. Consequently, the two aspects of the PCA can be displayed on one factorial map. The individual scores of the dogs are represented, for instance, in the two first factors. The new variables, combinations of the 16 behavioural categories, constructed through the PCA are projected onto these two factors, multiplied by a rescaling constant. To properly understand the relationship between the original variables and the constructed components, correlations can be computed. Lastly, the PCA reduced the number of variables describing the behavioural

Table 1. Behavioural categories.

1. *Activity*: standing; walking; trotting; galloping; in/out; digging; jumping on roof; looking/pointing cats; scratching door.
2. *Aggressiveness towards humans*: growling; transverse glance; fur raising; lip curling; showing teeth; biting bars; dashing at bars.
3. *Aggressivenes towards dogs*: growling; transverse glance; fur raising; lip curling; showing teeth; dashing at bars.
4. *Anxiety*: scratching; circling; jumping; yawning; licking chops; catching flies; self-grooming; whining; body-shaking; self-mutiliation; licking objects persistently.
5. *Attentiveness*: ears up; prompt; looking outside; looking at observer; looking out carefully; looking at unknown people; looking at the environment; looking at volunteer; looking at dog; looking at cat; raising fore leg; sniffing air; sniffing environment; sniffing unknown people; sniffing observer; sniffing faece of other dogs; sniffing volunteer; sniffing dog.
6. *Dominance towards humans*: staring; tail still; tail high; waving high tail; jumping upon *somebody;* upright.
7. *Dominance towards dogs*: staring; tail still; tail high; waving high tail; mounting; upright.
8. *Dominance generic*: scratching with hind legs; urinating with a raised leg.
9. *Subordination towards humans*: avoiding being looked at; lowering head; tail between legs; tail down; ears down; lying on its back.
10. *Subordination towards dogs*: avoiding being looked at; lowering head; tail between legs; tail down; ears down; lying on back; licking the mouth of another dog.
11. *Excitability*: slavering; looking/pointing/following cat; sniffing cat; galloping; mounting; jumping upon.
12. *Playfulness*: playing; inviting to play; answering invitations to play; showing object.
13. *Vocal communicability*: barking; whining; grumbling; mumbling; howling; snorting.
14. *Sociability towards humans*: waving tail; following observer; approaching observers; giving the foreleg; accepting being cuddled; licking face; leaning on observer; leaning on bars; answering invitation to play; inviting to play.
15. *Sociability towards other dogs*: waving tail; leaning on a dog; allo-grooming; inviting to play; sniffing dog; anogenital sniffing; anogenital licking.
16. *Quiet-laziness*: lying down; curling up; sitting; dozing.

patterns, indicating whether these go in the same direction or not. Therefore, the PCA allows characterisation of the animals by common or opposite behavioural patterns and is a way of building a typology of individuals.

Spearman rank correlation was used to test the association between the individual score recorded by each dog for each factor pointed out by the PCA and the numerical scores in which there was conversion of the dogs' rating of fear of novel environments, as well as time of stay in the shelter and the concentration of faecal CM. Significance by chance, due to multiple testing of the various dog scores, was controlled through Bonferroni corrections.

Furthermore, since the data were gathered by three people, a test to evaluate interindividual-reliability was necessary and Kendall's kappa coefficient was applied (Martin & Bateson, 1993).

Results

Inter-observer reliability

The value of agreement between observers deemed acceptable to avoid biased results is 0.75. In this study, the agreement between CDP and EB was equal to 0.85; between EB and EV was equal to 0.89; between CDP and EV was equal to 0.82.

Temperament of dogs

The Principal Component Analysis (PCA) identified five primary factors (or axes) with eigen values greater than 1 that explained 56% of the total variability (also called 'inertia'). Any correlation of 0.50 or above is deemed relevant for the variable loading on each factor. (Table 2). Thus, the first factor (F1) has been defined 'subordination/aggressiveness'; the second (F2) 'intra-specific dominance-activity'; the third (F3) 'anxiety-sociability towards dogs', the fourth (F4) 'playfulness' and the fifth (F5) 'sociability towards humans' (Table 2; Figure 1). Furthermore, the PCA also assigns an 'individual score' to each dog for each factor. This means that dogs with a high negative F1 value were individuals with a temperament characterised by aggressiveness and attitudes of subordination. Dogs with a high negative F2 value were animals with a temperament characterised by high level of physical activity, excitability and attitudes of dominance. Dogs with a high negative F3 value were individuals with a temperament characterised by intra-specific social attitudes and low levels of anxiety; dogs with a high negative F4 value had a playful temperament and that on the other hand did not pay attention to the surrounding environment. Finally, dogs with a high negative F5 value were animals with a temperament characterised by inter-specific social attitudes (i.e., very sociable to human beings).

Dogs characterised by a high individual score for the second factor, 'intraspecific dominance-activity', recorded a high score in behavioural tests on independence from humans (Spearman rank correlation test: $\rho = 0.269$;

Table 2. Results from the PCA. The loadings of 0.50 or above are pointed out because of their relevance for the variable on the factor.

	1st Factor Subordination/ aggressiveness	2nd Factor Intra-specific dominance-activity	3rd Factor Anxiety-sociability tws dogs	4th Factor Playfulness	5th Factor Sociability tws humans
Activity	0.10	**−0.66**	0.26	−0.01	0.33
Aggressiveness tws humans	**−0.73**	−0.02	−0.01	−0.09	−0.03
Aggressiveness tws dogs	**−0.54**	−0.12	−0.02	−0.30	−0.28
Anxiety	0.07	−0.34	**0.67**	0.19	−0.08
Attentiveness	−0.16	−0.43	−0.17	**0.55**	0.32
Dominance tws humans	−0.49	−0.49	0.05	0.20	−0.09
Dominance tws dogs	0.28	**−0.64**	−0.21	−0.21	−0.11
Dominance generic	0.27	0.26	0.07	0.38	−0.15
Subordination tws humans	**−0.70**	−0.02	−0.26	−0.08	−0.27
Subordination tws dogs	**−0.76**	0.10	−0.18	0.004	0.29
Excitability	0.27	**−0.70**	−0.15	−0.12	0.04
Playfulness	0.17	0.06	0.00	**−0.61**	−0.04
Vocal communic.	−0.44	−0.21	0.45	−0.32	−0.39
Sociability tws humans	0.00	−0.24	−0.38	0.17	**−0.60**
Sociability tws dogs	0.29	−0.15	**−0.60**	−0.33	0.11
Quiet-laziness	−0.17	−0.05	−0.36	0.37	−0.48

$N = 74$; $p = 0.02$, tendency, following Bonferroni correction) but neither the first nor the second were correlated with dogs' rated fear in new environments ($\rho = 0.141$; $N = 74$; NS; $\rho = -0.095$; $N = 74$; NS, respectively).

It has to be pointed out that neither stereotypies nor behaviour that denotes lack of interest to the surrounding environment were ever shown by the 74 dogs.

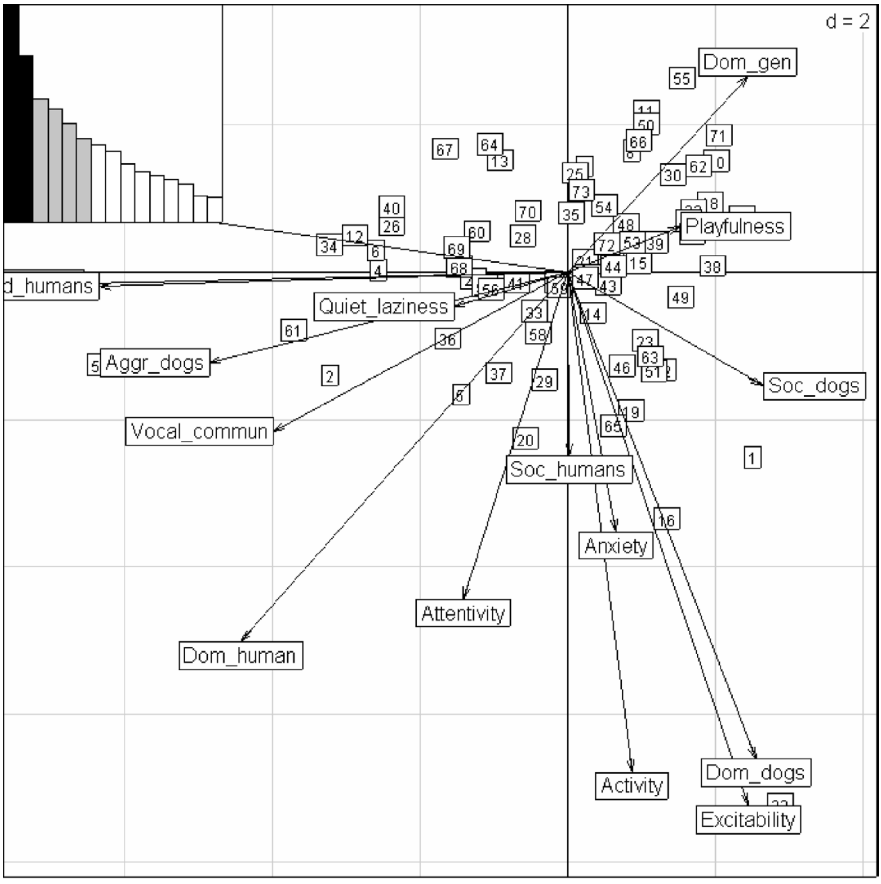

Figure 1. Factorial map of the 74 dogs and projection of the vectors built by the PCA — combinations of the 16 behavorial categories — multiplied by a constant of rescaling. In the top left-hand corner, bar plot of the eigenvalues — in black the axes used for the plot, in grey the other axes kept in the analysis, in white, the non used axes — showing the variance explained by each factor.

Faecal cortisol metabolites

The median concentration of CM of 39 dogs (for which it was possible to collect enough faecal samples) was 8.6 ng/g faeces (range 1.9-58.7). Individual scores of F5 identified by the PCA 'sociability towards humans', as well as length of permanence in the shelter (average: 6.3 months, range 1-19 months) were inversely related to the level of faecal CM, although the correlation did not reach a significant level ($\rho = -0.276$, $N = 39$, $p = 0.08$, tendency;

$\rho = -0.328$, $N = 39$, $p = 0.04$, tendency, following Bonferroni correction, respectively). However, the dogs' fear of novel environments, showed no correlation with concentration of faecal CM ($\rho = -0.157$, $N = 39$, NS).

Discussion

Temperament of dogs

The results of the PCA and of behavioural tests carried out in this study suggest that it is possible to identify some characteristics of the temperament of dogs housed in the shelter. Individuals that had a high score for the second factor of the PCA named 'intraspecific dominance-activity' were active, excitable dogs, dominant in intraspecific relationships and independent from humans, as confirmed by behavioural tests; in other words, with a temperament characterised by self-confidence, with cross-situational stability. However, neither the second factor 'Intraspecific dominance-activity', nor 'independence from humans', correlated with the dogs' rating for fear of novel environments. The dogs that showed a confident-independent temperament in a familiar context (in the box and in the fenced area, within the shelter) did not show willingness to approach a novel situation and to take risks in a new, unknown context (the street outside the shelter). The cross-situational stability of their temperament disappeared and these dogs cannot be defined as 'bold', or 'proactive', according to the currently accepted definition reported above (Koolhaas et al., 1999). Nevertheless, some other considerations are due: after 6 months of stay (on average) in the shelter, going out of the shelter can be seen as a break in routine. Thus, the interpretation of these results can be controversial: in fact, proactive or bold individuals are defined 'quicker than reactive individuals to explore, and try to manipulate the situation even if the context is new' and, at the same time, 'more prone to form routine' and 'less prone to innovate' (Koolhaas et al., 1999; Sih et al., 2004; Groothuis & Carere, 2005). Which element is prevailing in this case? Svartberg & Forkman (2002) also found five dimensions, i.e. 'playfulness', 'curiosity/fearlessness', 'chase-proneness', 'sociability' and 'aggressiveness' that showed higher cross-situational stability than in our study. Nevertheless, although their dimension 'curiosity/fearlessness' might have given indications about which dog could have been defined as 'bold' or 'shy', they did not discuss the results in this terms, maybe because it was

considered too early on the basis of the current knowledge on dogs. In fact, later Svartberg et al. (2005) suggested that the magnitude of behaviour related to fearfulness in the dog is sensitive to novelty, so the consistency of personality traits related to fear might be less than for other traits.

The results of this study may also point out the difficulty of applying standardised dog behavioural tests to a sample of shelter dogs that do not have a common origin. The present PCA identified five primary factors that explained 'only' 56% of the total inertia, so the variability of the dogs' behaviour was very high. This was probably due to the fact that the dogs were not homogenous with regards to breed and life history. Standardised dog behavioural tests like the 'dog mentality assessment' (DMA, Svartberg & Forkman, 2002; Svartberg et al., 2005; Svartberg, in press) or the method developed by Serpell & Hsu (2001) for evaluating temperament in guide dogs, are of great help in predicting dog behaviour and are valuable for their applicability and reproducibility. However, they should be applied to dogs that have a similar background. In general, standardised dog behaviour tests consist of exposing the dogs to several different novel situations and their reactions are described according to a standardised score sheet by official observers, one at every test. It might be incorrect to compare the reaction of a dog born as stray with the reaction of a dog born as a pet and then, when adult, consigned to the shelter, to the sudden appearance of a human-like dummy, or to a metallic noise or, even, to a gunshot. All dogs housed in a shelter have undergone some traumas, such as having been mistreated and suddenly having experienced captivity (stray dogs), or having been abandoned (pets), but the kind of traumas are too different in order to be able to relate the capacity of dogs to cope with further traumatic events. Behavioural tests have to be as simple as possible in order to prevent biases. For example, Weiss & Greenberg (1997) verified the effectiveness of 'service dog selection tests' for dogs from animal shelters. They concluded that there was not only the possibility that the test utilised was not sufficiently sensitive, but also that it could have reflected the differences in environment between dogs raised in a home or laboratory setting and various environments encountered by dogs found in a shelter (Weiss & Greenberg, 1997). High noise levels, the unusual environment, food, the presence of other conspecifics and visitors make the dogs less likely to react in a 'normal' fashion to some of the novel stimuli presented during testing.

Nevertheless, on average the dogs housed in this shelter in Rome showed less signs of stress that one might expect, given the restricted areas in which they lived: they showed neither stereotypies nor inactivity and lack of interest in the surrounding environment. Beerda et al. (1997) pointed out that housing conditions that lack suitable stimuli to elicit behaviour and adequate space to perform behaviour might make dogs inactive without causing stress response. Moreover, Hubrecht et al. (1992) reported that solitary housing in restricted areas induces dogs to perform more repetitive movements such as pacing, tail chase, wall bounce and flank sucking. It is possible that for the subjects of this study being housed in pairs acted as a social buffer compensating for the lack of space.

Faecal cortisol metabolites

An increased level of cortisol indicates acute stress in dogs, whether measured in plasma, urine or saliva (reviewed in Beerda et al., 1999b). Moreover, it has been found that chronic stress, too, is evinced by elevated adrenocortical activity (Beerda et al., 2000). Unfortunately, with shelter dogs like the subjects of this study, the applicability of plasma cortisol level as a measure of chronic stress is problematic, since the procedure of blood sampling itself can easily affect the levels. The same consideration, although to a lesser extent, applies to the collection of urine or saliva. In contrast, faecal samples offer the advantage that they can be collected non-invasively. Such methods measuring faecal CM have been successfully established in a wide variety of animals including dogs (Touma & Palme, in press). In addition, unlike blood samples, faecal samples are less affected by episodic or diurnal fluctuations, although the latter have not been reported in dogs, even in blood samples (Thun et al., 1990; Kemppainen & Sartin, 1994). Thus, concentrations of faecal CM probably reflect basal adrenocortical activity adequately or even better than those measured in the blood, saliva or urine (Touma & Palme, in press).

A moderate level of stress of these dogs was denounced by the median concentration of CM found (8.6 ng/g) for the 39 dogs for which it was possible to collect the samples. The only median concentrations of basal faecal CM reported in the literature for dogs were lower, i.e., 0.64 ng/g (Palme et al., 2001) and 2.43 ng/g (Schatz & Palme, 2001). However, their dogs were born and reared under laboratory conditions and accustomed to

various manipulations. Those dogs probably lived in conditions less stressful than the shelter environment and their lower basal values might reflect such a difference.

Interestingly, in the present study the dogs that showed lower levels of CM were the ones more accustomed to human beings, being very friendly and dependent on them. Furthermore, according to Mondelli et al. (2003) dogs that had a longer stay in the shelter showed a lower level of faecal CM, as found by Hennessy et al. (1997) for plasma cortisol levels: during the first days of stay in the shelter cortisol concentrations were higher than on subsequent days. This confirms, once again, that dogs share the characteristic of being routine-based animals: the more consolidated the daily routine is, due to a longer stay in the same environment, the less they show signs of stress.

In conclusion, despite all the limits posed by few or no statistically significant positive results, this study provides some hints on the possibility to outline the temperament of shelter dogs by means of standard ethological methods, matched with some physiological information, not with standing the constraints due to the specific context. The benefits of standard ethological methodology are mainly two: first, it is less difficult to apply than standardised dog behavioural tests and thus shelter staff can easily learn it with a short training; second, a behavioural profile of the dogs can guide people towards an acquainted adoption, raising the probability of its success.

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References

Altman, S.A. (1974). Observational study of behaviour: sampling methods. — Behaviour 49: 227-267.

Anestis, S.F. (2005). Behavioral style, dominance rank, and urinary cortisol in young chimpanzees (*Pan troglodytes*). — Behaviour 142: 1251-1274.

Beaver, B.V. (1983). Clinical classification of canine aggression. — Appl. Anim. Ethol. 10: 35-43.

Beerda, B., Schilder, M.B.H., Bernadina, W., van Hooff, J.A.R.A.M., de Vries, H.W. & Mol, J.A. (1999a). Chronic stress in dogs subjected to social and spatial restriction. I. Behavioral responses. — Physiol. Behav. 66: 233-242.

Beerda, B., Schilder, M.B.H., Bernadina, W., van Hooff, J.A.R.A.M., de Vries, H.W. & Mol, J.A. (1999b). Chronic stress in dogs subjected to social and spatial restriction. II. Hormonal and immunological responses. — Physiol. Behav. 66: 243-254.

Beerda, B., Schilder, M.B.H., van Hooff, J.A.R.A.M. & de Vries, H.W. (1997). Manifestations of chronic and acute stress in dogs. — Appl. Anim. Behav. Sci. 52: 307-319.

Beerda, B., Schilder, M.B.H., van Hooff, J.A.R.A.M., de Vries, H.W. & Mol, J.A. (1998). Behavioural, saliva cortisol and heart rate responses to different types of stimuli in dogs. — Appl. Anim. Behav. Sci. 58: 365-381.

Beerda, B., Schilder, M.B.H., van Hooff, J.A.R.A.M., de Vries, H.W. & Mol, J.A. (2000). Behavioral and hormonal indicators of enduring environmental stress in dogs. — Anim. Welf. 9: 49-62.

van der Borg, J.A.M., Netto, W.J. & Planta, D.J.U. (1991). Behavioural testing of dogs in animal shelters to predict problem behaviour. — Appl. Anim. Behav. Sci. 32: 237-251.

Carere, C., Groothuis, T.G.G., Mostl, E., Daan, S. & Koolhaas, J.M. (2005). Fecal corticosteroids in a territorial bird selected for different personalities: daily rhythm and the response to social stress. — Horm. Behav. 43: 540-548.

Cavigelli, S.A. (1999). Behavioral patterns associated with faecal cortisol levels in free-ranging female ring-tailed lemurs, *Lemur catta*. — Anim. Behav. 57: 935-944.

Cavigelli, S.A. & McClintock, M.K. (2003). Fear of novelty in infant rats predicts adult corticosterone dynamics and an early death. — PNAS 100: 16131-16136.

Feaver, J., Mendl, M. & Bateson, P. (1986). A method for rating the individual distinctiveness of domestic cats. — Anim. Behav. 34: 1016-1025.

Goddard, M.E. & Beilharz, R.G. (1984). A factor analysis of fearfulness in potential guide dogs. — Appl. Anim. Behav. Sci. 12: 253-265.

Goddard, M.E. & Beilharz, R.G. (1985). Individual variation in agonistic behaviour in dogs. — Anim. Behav. 33: 1338-1342.

Gosling, S.D. (1998). Personality dimention in spotted hyenas (*Crocuta crocuta*). — J. Comp. Psychol. 112: 107-118.

Gosling, S.D. (2001). From mice to men: what can we learn about personality from animal research? — Psych. Bull. 127: 45-86.

Gosling, S.D. & Bonnenburg, A.V. (1998). An integrative approach to personality research in anthrozoology: rating of six species of pets and their owners. — Anthrozoos, 11: 148-156.

Gosling, S.D. & John, O.P. (1999). Personality dimensions in non-human animals: a cross-species review. — Curr. Dir. Psychol. Sci. 8: 69-75.

Groothuis, T.G.G. & Carere, C. (2005). Avian personalities: characterization and epigenesis. — Neurosci. Biobehav. Rev. 29: 137-150.

Hennessy, M.B., Davis, H.N., Williams, M.T., Mellott, C. & Douglas, C.W. (1997). Plasma cortisol levels of dogs at a county animal shelter. — Physiol. Behav. 62: 485-490.

Hennessy, M.B., Voith, V.L., Hawke, J.L., Young, T.L., Centrone, J., McDowell, A.L., Linden, F. & Davenport, G.M. (2002a). Effects of a program of human interaction and alterations in a diet composition on activity of the hypothalamic-pituitary-adrenal axis in dogs housed in a public animal shelter. — J. Am. Vet. Med. Ass. 221: 65-71.

Hennessy, M.B., Voith, V.L., Mazzei, S.J., Buttram, J., Miller, D.D. & Linden, F. (2001). Behaviour and cortisol levels of dogs in a public animal shelter, and an exploration of the ability of these measures to predict problem behaviour after adoption. — Appl. Anim. Behav. Sci. 73: 217-233.

Hennessy, M.B., Voith, V.L., Young, T.L., Hawke, J.L., Centrone, J. & McDowell, A.L. (2002b). Exploring human interaction and diet effects on the behavior of dogs in a public animal shelter. — J. Appl. Anim. Welf. Sci. 5: 253-273.

Hennessy, M.B., Williams, M.T., Miller, D.D., Douglas, C.W. & Voith, V.L. (1998). Influence of male and female petters on plasma cortisol and behaviour: can human interaction reduce the stress of dogs in a public animal shelter? — Appl. Anim. Behav. Sci. 61: 63-77.

Hubrecht, R.C., Serpell, J.A. & Poole, T.B. (1992). Correlates of pen size and housing conditions on the behaviour of kennelled dogs. — Appl. Anim. Behav. Sci. 34: 365-383.

van Hooff, J.A.R.A.M. (1973). A structural analysis of the social behavior of a semi-captive group of chimpanzees. — In: Social communication and movement (von Cranach, M. & Vine, I., eds). Academic Press, London: 75-162.

Kemppainen, R.J. & Sartin, J.L. (1984). Evidence for episodic but not circadian activity in plasma concentrations of adrenocorticotrophin, cortisol and thyroxine. — J. Endocr. 103: 219-226.

Koolhaas, J.M., Korte, S.M., de Boer, S.F., van der Vegt, B.J, van Reenen, C.G., Hopster, H., de Jong, I.C., Ruis, M.A.W. & Blokhuis, H.J. (1999). Coping styles in animals: current status in behavior and stress physiology. — Neurosci. Biobehav. Rev. 23: 925-935.

de Lathouwers, M. & van Elsacker, L. (2004). Comparing maternal styles in bonobos (*Pan paniscus*) and chimpanzees (*Pan troglodytes*). — Am. J. Primatol. 64: 411-423.

Maarschalkerweerd, R.J., Endenburg, N., Kirpensteijn, J. & Knol, B.W. (1997). Influence of orchiectomy on canine behaviour. — Vet. Rec. 140: 617-619.

Martin, P. & Bateson, P. (1993). Measuring behaviour. — Cambridge University Press, Cambridge.

Matsumuro, M., Tadashi, S., Fumiaki, C., Yasuhiro, Y. & Takashi, Y. (1999). A two-step extraction method measure fecal steroid hormones in female cynamolgus monkeys (*Macaca fascicularis*). — Am. J. Primatol. 48: 291-298.

Miller, D.D., Staats, S.R., Partlo, C. & Rada, K. (1996). Factor associated with the decision to surrender a pet to an animal shelter. — J. Am. Veter. Ass. 209: 738-742.

Mondelli, F., Zannoni, S., Berretta, V., Accorsi, P. & Valsecchi, P. (2003). Behavioral adaptation of dogs entering a rescue shelter. — Proceedings of ASAB summer meeting, Grünau, Austria.

Palme, R., Schatz, S. & Mostl, E. (2001). Einfluss der Impfung auf die Konzentration von Kortisolmetaboliten im Kot von Fleischfressern. — Dtsch. Tierarztl. Wschr. 108: 23-25.

Reid, J.B., Chantrey, D.F. & Davie, C. (1984). Eliminatory behaviour of domestic dogs in a urban environment. — Appl. Anim. Behav. Sci. 12: 279-287.

Schatz, S. & Palme, R. (2001). Measurement of faecal cortisol metabolites in cats and dogs: a non-invasive method for evaluation adrenocortical function. — Vet. Res. Com. 25: 271-287.

Sapolsky, R.M. & Ray, J.C. (1989). Styles of dominance and their endocrine correlates among wild olive baboons (*Papio anubis*). — Am. J. Primatol. 18: 1-13.

Serpell, J.A. & Hsu, Y. (2001). Development and validation of a novel method for evaluating behavior and temperament in guide dogs. — Appl. Anim. Behav. Sci. 72: 347-364.
Sih, A., Bell, A.M., Johnson, J.C. & Ziemba, R.E. (2004). Behavioral syndromes: an integrative overview. — Quart. Rev. Biol. 79: 241-77.
Sousa, M.B.C. & Ziegler, T.E. (1998). Diurnal variation on the excretion patterns of faecal steroids in common marmoset (*Callithrix jacchus*). — Am. J. Primatol. 46: 105-117.
Svartberg, K. (in press). A comparison of behaviour in test and in everyday life: evidence of three consistent boldness-related personality traits in dogs. — Appl. Anim. Behav. Sci.
Svartberg, K. & Forkman, B. (2002). Personality traits in the domestic dog (*Canis familiaris*). — Appl. Anim. Behav. Sci. 79: 133-155.
Svartberg, K., Tapper, I., Temrin, H., Radesater, T. & Thorman, S. (2005). Consistency of personality traits in dogs. — Anim. Behav. 69: 283-291.
Thun, R., Eggenberger, E. & Zerobin, K. (1990). 24-Hour profiles of plasma cortisol and testosterone in the male dog: absence of circadian rhythmicity, seasonal influence and hormonal interrelationships. — Reprod. Dom. Anim. 25: 68-77.
Touma, C. & Palme, R. (in press). Measuring fecal glucocorticoid metabolites in mammals and birds: the importance of a validation. — Ann. N. Y. Acad. Sci. 1046 (preprint online).
Tuber, D., Hennessy, M.B., Sanders, S. & Miller, J.A. (1996). Behavioral and glucocorticoid responses of adult domestic dogs (*Canis familiaris*) to companionship and social separation. — J. Comp. Psychol. 110: 103-108.
Veenema, A.H., Meijer, O.C., de Kloet, E.R. & Koolhaas, J.M. (2003). Genetic selection for coping style predicts stressor susceptibility. — J. Neuroendocrin. 15: 256-257.
Voith, V.L. & Borchelt, P.L. (1996). Separation anxiety in dogs. — In: Readings in companion animal behavior. (Voith, V.L. & Borchelt, P.L., eds). Veterinary Learning Systems, Trenton, NJ, p. 124-139.
Weiss, E. & Greenberg, G. (1997). Service dog selection tests: effectiveness for dogs from animal shelters. — Appl. Anim. Behav. Sci. 53: 297-308.
Whitten, P.L., Stavisky, R., Aureli, F. & Russell, E. (1998). Response of fecal cortisol to stress in captive chimpanzees (*Pan troglodytes*). — Am. J. Primatol. 44: 57-69.
Wilson, D.S., Clark, A.B., Coleman, K. & Dearstyne, T. (1994). Shyness and boldness in humans and other animals. — Trends Ecol. Evol. 9: 442-445.

Appendix 1: Ethogram of domestic dog (*Canis familiaris*)

Aggressive behaviour:

- *Growling*: threatening vocalisation coming from the throat.
- *Fur raising*: raising the fur of the head, body and tail so that the dog appears of larger size and thus more threatening.
- *Lip curling*: light raising of upper lip, usually only on one side, with a threatening partial display of the teeth.
- *Showing teeth*: curling of upper and lower lips while opening the mouth with a threatening display of the teeth, in particular of canine teeth.
- *Transverse glance*: looking transverse with the head upright or bent. The glance is threatening.

- *Biting bars*: biting the box's bars.
- *Dashing at bars*: dashing at bars in the direction of the observer, of another person or of another dog.
- *Biting and shaking objects*: holding an object in the mouth and shaking it.

Dominant behaviour:

- *Staring*: gazing at the observer, another person or another dog right in the eyes.
- *Standing*: standing still in an upright posture, with the ears raised and turned forward, the four legs straight and rigid and the tail immobile and rigid at a medium height.
- *Jumping upon*: jumping up on its hind legs, the dog leans its forelegs on the observer.
- *Mounting*: mounting another dog or the observer showing pelvic thrusts.

Submissive behaviour:

- *Lowering head*: lowering the head in front of the observer, another person or another dog.
- *Tail between the legs*: the tail is kept between the hind legs, covering genital organs to impede sniffing in this zone.
- *Licking the mouth of another dog*: licking the corner of the mouth of another dog.
- *Lying on its back*: lying down with the legs open, exhibiting the ventral region.
- *Crouching with its belly on the ground*: lying with the ventral region in contact with the ground.
- *Avoiding being looked at*: looking away from the observer, another person or another dog, who is looking at the subject.

Positions of the ears:

- *Ears up*: raising the ears turning them forward, showing attention to somebody or something.
- *Ears backwards*: putting the ears backwards.
- *Ears down*: putting the ears down, pressed on the head, in a submissive posture.

Positions of the tail:

- *Tail still*: the tail is still and rigid at a medium height.
- *Tail high*: the tail is held high.
- *Tail down*: the tail is held down.
- *Waving tail*: the tail is waved intensely.
- *Waving high tail*: the tail is waved while kept high.

Attitude:

- *Indifferent towards the barking of other dogs*: the dog is indifferent when other dogs are barking.
- *Prompt*: ready to spring towards a stimulus with the ears raised, watchful eyes, the tail still and the whole body vibrating.

Attention:

- *Looking outside*: looking outside the box.
- *Looking at observer*: looking at the observer.
- *Looking out carefully*: looking outside the box very carefully; the position resembles that described for 'prompt' but the dog is not ready to spring up.

- *Looking at unknown people*: looking at people the dog does not know.
- *Looking at the environment*: looking around at various objects of the environment.
- *Looking at volunteer*: looking at a shelter volunteer worker.
- *Looking at dog*: looking at another dog.
- *Raising foreleg*: raising one foreleg.
- *Raising forelegs on wall*: raising both forelegs onto the wall or onto the bars, looking carefully outside.

Sniffing:

- *Sniffing air*: raising the head, moving the nostrils and breathing the air, to perceive odours.
- *Sniffing observer*: pointing the muzzle towards the observer, the dog moves the nostrils clearly trying to perceive the odours of observer.
- *Sniffing environment*: putting the muzzle on the ground, on the wall, or on the objects in the box, the dog sniffs the environment.
- *Sniffing unknown people*: pointing the muzzle towards people the dog does not know, the dog moves the nostrils clearly trying to perceive their odours.
- *Sniffing volunteer*: pointing the muzzle towards a volunteer working in the shelter, the dog moves the nostrils clearly trying to perceive his odours.
- *Sniffing dog*: pointing the muzzle towards another dog, the subject moves the nostrils clearly trying to perceive its odours.
- *Sniffing cat*: pointing the muzzle towards a cat, the dog moves the nostrils clearly trying to perceive its odours.
- *Sniffing faeces of other dogs*: sniffing the faeces of other dogs.

Displacing activities:

- *Scratching*: raising one hind leg and scratching itself vigorously.
- *Yawning*: opening the mouth and inhaling and exhaling air.
- *Circling*: running around circling itself. When this behaviour is recorded in the box it might take the place of running.
- *Jumping*: jumping with all four legs, falling down on the same place.
- *Licking chops*: passing the tongue on the lips and on the chops.
- *Body shaking*: shaking the body generally to clean the coat (for example from water).

Stereotypies:

- *Self-mutilation*: licking itself continuously in the same place of the body, so intensely as to cause abrasions or even wounds.
- *Licking objects persistently*.
- *Catching flies*: trying to catch an imaginary fly with the mouth.

Grooming:

- *Self-grooming*: cleaning itself with the tongue and the teeth.
- *Allo-grooming*: cleaning another dog, licking and nibbling.

Vocalisations:

- *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.
- *Mumbling*: vocalisation that consists in a sort of inside murmur.
- *Howling*: vocalisation characteristic of wolves, this consists in a long, high and mournful sound; quite rare in dogs.
- *Snorting*: vocalisation emitted by the dog while puffing out its cheek and emitting air.

Physiological activities (urinating, defecating, etc.):

- *Urinating*: emitting urine in a crouching position.
- *Defecating*: emitting faeces in a crouching position.
- *Urinating with a raised leg*: emitting the urine with one hind leg raised, so that the urine goes beside the body.
- *Urinate jumping*: emitting the urine while jumping.

Positions of the body:

- *Lying down*: lying down on the ground.
- *Curling up*: curling up on the ground; the dog is relaxed and tends to doze.
- *Sitting*: sitting down with the rump leaning on the ground.
- *Upright*: standing up on four legs.

Activity:

- *Dozing*: curling up, the dog is half asleep.
- *In/out*: going in and out of the indoor/outdoor zone of the box.
- *Jumping on the roof*: going on the roof in the fenced area inside the shelter.
- *Looking/pointing a cat*: looking at a cat in an intense way.
- *Walking*: walking in the fenced area within the shelter.
- *Trotting*: trotting in the fenced area within the shelter.
- *Galloping*: galloping in the fenced area within the shelter.
- *Playing*: playing alone.
- *Scratching door*: scratching the door with a fore leg.
- *Digging*: digging on the ground with the fore legs, to make a hole.
- *Scratching with hind legs*: scratching the ground with the hind legs after having urinated or defecated.
- *Biting object*: biting an object of the environment.
- *Licking faeces*: licking the faeces of another dog.
- *Licking of environment*: licking the ground, the wall, the bars or other objects of the environment.
- *Slavering*: emitting saliva from the mouth.
- *Following cat*: chasing a cat after having intensely stared at it.
- *Getting frightened by unknown noises*: being frightened by unknown noises.

Affiliative behaviour:

- *Following observer*: following the observer walking.
- *Inviting to play*: inviting another dog or human being to play: the dog bends down with the forelegs outstretched on the ground and the rump upwards, or brings an object, runs round and jumps.

- *Accepting being cuddled*: approaching an observer who kneels down and calls it, the dog is still near the observer and accepts being cuddled.
- *Giving the foreleg*: raising one of the forelegs and leaning it on a hand of the observer that has asked for it.
- *Conspecific sniffing*: sniffing another dog.
- *Anogenital licking*: licking the genital zone of another dog.
- *Leaning on observer*: laying its body in direct contact with an observer, it can move with bodily strength in order to be cuddled, reassured, etc.
- *Showing object*: taking an object and showing it to the observer.
- *Anogenital sniffing*: pointing the muzzle towards the genital zone of a companion, dilating the nostrils and moving them to perceive odours of the companion's genital zone.
- *Leaning on a dog*: leaning the body in direct contact with another dog.
- *Approaching*: reducing the distance between itself and the observer.
- *Remaining still near observer*: remaining near the observer.
- *Walking near observer's foot*: walking remaining near the observer's foot.
- *Responsive to commands*: responding positively to the order 'sit down!'
- *Responsive to recall*: obeying an order of the observer.
- *Answering to the invitation to play*: playing with the observer after having been invited to do so.
- *Nose to nose*: approaching its muzzle to the observer's nose.
- *Licking face*: licking the observer's face.
- *Leaning on bars*: leaning the body in direct contact with the bars of the box.