Consistency of dogs' reactions to threatening cues of an unfamiliar person

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Abstract

Reliability is one of the most important aspects of the behaviour observations measuring personality traits in animals. The most fundamental way to test reliability is the assessment of the test–retest consistency. On the other hand, in situations where social interaction between a human participant and the animal subject is at the scope of the study, the behaviour of the humans in the test situation should be restricted by a set of rules. However, if more than one experimenter participates in the observations, the similarity of the behaviour of different persons is an important aspect of the reliability of the study.

In our first study we investigated the consistency of dogs' behaviour during approach by a person in a friendly and in a threatening way, repeating the test either immediately after the first test or at least 6 months later. We found that the dogs' sensitivity to the human's behavioural cues in this situation proved to be consistent over repetition when the second test was performed approximately 1 year after the first test, but it was not the case when the time elapsed between test occasions was a few seconds. The detailed analysis indicated that dogs performing extreme behaviour (friendly or threatening) tended to show more conservative responses than dogs showing intermediate reactions when the stranger approached threateningly. Nonetheless, the reaction of the dogs failed to be in accordance with the opinion of the owners about the dogs' behaviour in similar situations in everyday life.

In the second study we examined the consistency of the dogs' behaviour in the same situation when confronted with two different unfamiliar persons immediately after each other. The consistency of the dogs' response to the two experimenters was found to be reliably high.

In sum, this test procedure proved to be reliable enough to be a valuable measure of a definite part of the personality characters of dogs.
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Keywords: Dog; Social behaviour; Aggression; Personality; Consistency

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1. Introduction

Differences and similarities between individual behaviours are often referred to as a result of some sort of adaptive mechanisms (both in terms of evolution and individual development) forming personality types (Carere and Eens, 2005). Recently, many reviews have been devoted to dog personality traits (e.g. Ruefenacht et al., 2002; Svartberg, 2005; Taylor and Mills, 2006; Diederich and Giffroy, 2006) indicating that this issue has become centre of interest of the dog behaviour studies. Many suggest that personality traits represent a higher level of behavioural organization because they are defined as the resultants of several more elementary behavioural traits (e.g. Jones and Gosling, 2005).

Consistency of individual behavioural features is one of the most important aspects of personality (Svartberg, 2005) because the concept of personality rests on the condition that these traits are stable features of the individual. Experimentally, this means that individuals behave consistently across similar situations. In line with this, an increasing number of studies have focused on behaviour consistency in adult dogs that can be tested by the repetition of the same situation within a test battery. For example, in the Dog Mentality Assessment test (Svartberg and Forkman, 2002) there are two "play" test units: one in the second and one in the ninth place of the test battery. Although play behaviour correlates between the two units, this method brings in the problem that some short-term "transmitting" effects of habituation or sensitisation can affect the behaviour, leading to an overestimation of the individual consistency of the observed behaviour trait.

To avoid this problem, Svartberg et al. (2004) proposed a longer inter-test-interval time as another way of revealing behavioural consistency. They have studied the behaviour of 41 dogs of 29 breeds in a test battery, where the subjects were tested twice with an average of 1month elapsing between the experimental observations. Results showed reliable individual differences and stable dispositions to perform consistent behaviour regarding Playfulness, Chase-proneness, Sociability and Boldness, but not in the case of Curiosity/Fearfulness and Aggression.

Focusing on a specific breed, the reproducibility of behaviour in German Shepherd dogs was examined using an extremely long test–retest interval time (Fuchs et al., 2005). Most of the general traits they measured (self-confidence, nerve stability, reaction to gunfire, hardness, temperament, sharpness) proved to be consistent when test situations were repeated 1 year after the first observations. Others have studied more specific aspects of personality characteristics such as aggression, showing a relatively high level of test–retest correlation (Netto and Planta, 1997). When the forms and levels of aggression were observed repeatedly in three different test situations (in a playful interaction; when approached by a human dressed like a ghost; and when a human-like dummy appeared suddenly in front of the dog) individual consistency measured by Cronbach's alpha values was not found in adult dogs (Svartberg, 2005). Moreover, measuring aggression at different stages of development (at 6 and 12 months of age) also failed to show individual stability (Goddard and Beilharz, 1985). Some argue that aggression is a complex trait including different types of aggression (e.g. Svartberg, 2005), and this phenomena manifests in inconsistency between situations. One important factor leading to modifications in the situational aggression and in other aspects of behaviour could be for example the uncontrolled changes in the social environment (housing conditions) between the two tests.

The significant effect of the dog–human relationship was underlined by the study showing that intimate human–dog companionship disposes the dogs to show lower levels of competitive aggression (Jagoe and Serpell, 1996). Studying the behaviour of a specific breed (English Cocker Spaniel), however, others concluded just the opposite (i.e. pet dogs are more aggressive, Podberscek and Serpell, 1997). Another aspect of the social environment is the function of the

dog (keeping purpose). It has been shown that dogs kept for ''working'' or for ''show'' purposes tend to show a lower degree of both dominance and competitive types of aggression (Jagoe and Serpell, 1996). Regarding the dogs' training skills, it was found that higher level of aggression was associated with unwillingness to obey (Podberscek and Serpell, 1997) and higher level of obedience training correlates negatively with separation-related problems and overexcitement in some situations (Jagoe and Serpell, 1996).

Importantly, when studying the question of whether different manifestations of aggression can be regarded as consistent phenotypic traits of the dog, in addition to behaviour observations, we should also keep control over the above-mentioned factors.

Many assume that questionnaire analysis could be a relevant methodological tool in this regard. Questionnaires filled in by the owner are often used for studying temperament traits of dogs (e.g. Serpell and Hsu, 2001; Vas et al., 2007) on the basis of the assumption that the owner who lives with the dog knows the behaviour of his/her dog well (similarly to parents living with their infants). Moreover, questionnaires can also be used for ''validation'' purposes: when the owner, on the basis of extensive experience with his/her dog, gives estimation to the dog's behaviour expected in the test situation. For example van den Berg et al. (2003) conducted a series of test situations designed to evoke aggression and/or fear in Golden Retrievers. Before the behaviour observations, dogs were categorized into two distinct groups (owner-acknowledged aggressive and owner-acknowledged non-aggressive subjects) on the basis of a questionnaire filled in by the owner. Dogs who were scored by their owners as aggressive individuals showed a higher level of general aggression during the observations, however, most of the owner-acknowledged non-aggressive dogs also showed explicit aggression in some of the test situations.

Although the interspecific form of aggression in dogs (i.e. aggression against humans) is often believed to be influenced by environmental factors such as socialization and individual experiences (Podberscek and Serpell, 1997), some of our recent results indicate the role of inherited traits leading to breed specific differences in the dogs' responsiveness to human (Vas et al., 2005). In that study we analysed the response of adult pet dogs (of various breeds) to an unfamiliar woman who expressed social behaviour cues of friendliness and threat sequentially. On the basis of their reaction dogs were classified in two distinct categories. All of the Belgian Shepherd dogs proved to be 'responsive' (i.e. they showed clearly distinguishable reaction towards the human depending on her way of approaching) and half of them performed aggressive behaviour towards the threatening human. In contrast, many of the retriever and sledge dogs (40%) were 'non-responsive' as they ignored the changes in the Stranger's behaviour and only 25% of them responded aggressively towards her during the Threatening approach. This study pointed to the role of selective breeding (i.e. for hunting or shepherd work) in the manifestation of dogs' sensitivity to human social releasers. Similar results were found by Svartberg (2006) indicating that selection for different purposes (show or working) is associated with differences between personality traits (playfulness, curiosity/fearlessness, sociability and aggressiveness) within many breeds.

However, as we have no data about the consistency of the dogs' observed response, it is not clear whether or not the method used in Vas et al. (2005) study is a reliable procedure for tracing some of the personality characters (e.g. stress coping styles, aggression) in dogs. The purpose of the present studies, therefore, was to make repeated behaviour observations on subjects from the same breed (using a larger sample of Belgian Shepherds—in Study I) and on a group of various-breed dogs. Our analysis focused on the consistency of the dogs' behaviour shown (I) towards the same stranger upon repeated tests and (II) towards different unfamiliar persons in the same situation. Behaviour recordings are completed with some questionnaire data regarding the dog's obedience training, housing conditions and social relationship with humans.

2. Study I

2.1. Methods

2.1.1. Subjects

Forty-nine Belgian Shepherd dogs and their owners were recruited on a voluntary basis. The sample was balanced for gender (26 males, 23 females) and the dogs' age ranged between 12 and 156 months at the time of the first experimental observations (mean ± S.E.: 5.36 ± 0.49 years). The owners' sex ratio was biased towards females (26 women and 7 men) and their age ranged between 14 and 60 years. Eight owners had more than one dog (6 ones had 2 dogs, two owners had 3 and 7 dogs respectively).

2.1.2. Procedure

Since the experimental arrangement and the procedure were identical to that used in an earlier study (Vas et al., 2005), here we give only a short description of the experimental conditions. Behavioural observations were made at a visually separated place in a park, which was familiar to the dogs. Subjects were tested individually when no other dogs were nearby. The dog was tethered with a 1.5-m long leash to an isolated tree and its owner stood half a meter behind it without moving or speaking. The dog was sitting or lying on the ground towards an unfamiliar young woman (J.V.—Stranger) who stood motionless 5 m from the dog.

The test trial consisted of two subsequent episodes; the Stranger first approached the dog in normal speed of walk whilst talking to it and finally petted it gently (friendly approach) and then (when the owner got the dog to its initial position) she stepped back to her starting position and approached the dog again. However, during this second approach she moved slowly and haltingly and looked steadily in the eye of the dog without any verbal communication (threatening approach). The behaviour of the Stranger was determined and standardized across subjects according to a series of 'If ...then...' rules (for a detailed description of these rules see Vas et al., 2005). The experimental arrangement is shown in Fig. 1.

After recording the first trial the subjects were divided into two groups:

'Immediate repetition' group ($N = 26$; 11 males, 15 females; age: 5.5 ± 0.7 years): subjects in this group were re-tested right after the first test (just a few seconds elapsed between the two test situations). Both tests were conducted by the same woman.

'Delayed repetition' group: the rest of the dogs ($N = 23$; 15 males, 8 females, age: 5.2 ± 0.7 years) were tested in the same situation 6–24 months later (the mean inter-trial interval was 12.8 ± 1.0 months). Importantly, the location of the testing, the order of the episodes (i.e. Friendly approach, then Threatening approach) and the Stranger were the same as at the first occasion.

2.1.3. Behaviour categorization

On the basis of the dogs' behaviour shown towards the Stranger, subjects were classified into different response categories. The trial was terminated if the dog performed one of the following behaviour patterns (1–4):
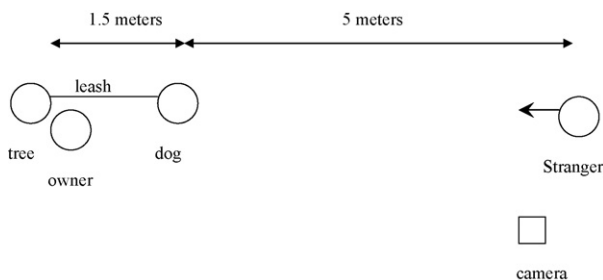

Fig. 1. Experimental arrangement.

(I)   Interrupted the eye contact with the Stranger and averted its gaze permanently (response category: Passive avoidant).
(II) Moved away behind the owner from the approaching Stranger whilst keeping eye contact (response category: Active avoidant).
(III) Barked or growled permanently and/or tried to attack the Stranger (response category: Threatening).
(IV) However, if the dog kept looking at the Stranger, then she continued to approach the dog and finally petted it (response category: Friendly/Passive).

For a more detailed description of the behavioural categorization, see Vas et al., 2005.

Moreover, in line with the behaviour analysis used in our former study (Vas et al., 2005) dogs were also categorized as either 'responsive' or 'non-responsive' based on the contact seeking-tolerating (Friendly/Passive behaviour) and contact avoiding (Passive avoidant, Active avoidant, Threatening) reaction. Those subjects were classified as 'responsive' who performed a flexible, relevant change in response to the altering cues of the Stranger (i.e. sought for contact with Friendly/Passive behaviour when greeted friendly and avoided contact with Passive avoidant, Active avoidant or Threatening response when approached threateningly). In contrast, dogs who showed permanent (predominantly Friendly/Passive) response and seemingly ignored the changes in Stranger's behaviour were regarded as 'non-responsive'.

2.1.4. Questionnaire data

Before the first observations, owners were asked to fill in a short questionnaire about their dogs (age, gender, keeping conditions, training qualification, intensity of social contact, aggression/fearful behaviours towards unfamiliar humans—see Table 1). Questionnaires of four dogs were excluded from the analysis because there were changes in the ownership and these dogs had been together with their recent owner for less than 6 months.

Questions 3 and 4 were both aimed to measure the amount of time spent together with the owner (intensity of social contact), therefore summary of the scores yielded in Q3 and Q4 was used for the analysis. Scoring system for Q3: Selecting answer 'a' or 'b' = 3, answer 'c' = 2, answer 'd' or 'e' = 1. Scoring for Q4: Selecting answer 'a' = 4, answer 'b' = 3, answer 'c' = 2, and answer 'd' = 1.

Answers to questions 5 and 6 were both related to the dog's negative attitudes toward unfamiliar humans, so the sum of the scores yielded in Q5 and Q6 was used for the analysis.

2.1.5. Data analysis

Dogs showing the same type of responsiveness in the second trial as observed on the first occasion were given a score of one (labelling a consistent responsiveness) whilst those who changed from 'non-responsive' to 'responsive' or vice versa, and those who showed different behaviour towards the threateningly approaching stranger in the first vs. repeated trial were scored as 0 (labelling an inconsistent responsiveness). The consistency on the group level (regarding the responsiveness, and the response category shown by the subjects) was analysed by binomial tests comparing the observed consistency to the chance level (0.5 in the case of two behavioural categories and 0.25 when analysing four categories). The effect of some independent variables (gender, training qualification, keeping condition) and questionnaire scores (attitude towards unfamiliar humans) on the consistency of the dogs responsiveness were analysed by Chi square (χ^2) tests and Mann–Whitney U-tests (in the case of negative attitudes toward unfamiliar humans and intensity of the social contact with the owner). For the statistical tests the SPSS 10 statistical package was used.

2.2. Results

2.2.1. Consistency of dogs' responsiveness—immediate re-testing

All dogs in the 'Immediate repetition' group showed contact seeking/tolerating behaviour (response category: Friendly/Passive) in the 'friendly approach' episodes of both trials. In the first trial 34.6% of the subjects ($N = 9$) proved to be 'non-responsive'; these dogs ignored the

changes in Stranger's behaviour (i.e. friendly/threatening) and continued to show Friendly/ Passive behaviour towards the threatening Stranger, whilst the others ($N = 17$) performed relevant change in their response showing passive or active avoidance or signs of aggression.

Given that dogs could behave either as 'responsive' or 'non-responsive', for the analysis we applied the null hypothesis that by chance half of the subjects would show consistent behaviour

Table 1
Questionnaire

Name of the owner:	Date:
Name and gender of the dog:	Birth of the dog:

1. Why do you keep your dog? (More answers may be signed)

a) as a companion (just for hobby)

b) guarding

c) other work (please specify: ……)

d) sport (please specify: ……)

e) breeding

2. What kind of organized training qualification was obtained by the dog? (More answers may be indicated)

a) nothing

b) basic obedience

c) Schutzhund

d) agility

e) other (please specify: ……)

3. What is your dog's main residential place?

a) the flat

b) the flat and the garden

c) the garden, free

d) the kennel

e) the garden, tethered

4. How much time do you attend to your dog daily (walking, playing, training, others)?

a) more than 3 hours

b) 1-3 hours

c) less than 1 hour

d) not me, but other family members attend to the dog

Table 1 (*Continued*)

5. Does it happen that your dog behaves aggressively toward an unfamiliar person?
1) never
2) sometimes
3) in the half of the cases
4) regularly
5) always when it has the opportunity
6. Does it happen that your dog behaves distrustfully toward an unfamiliar person?
1) never
2) sometimes
3) in the half of the cases
4) regularly
5) always when it has the opportunity

upon re-test (test proportion = 0.5). Comparisons show that dogs as a group did not show significant behavioural consistency ($p = 0.170$). Importantly, however, the consistency of the response depended on the reaction shown by the dogs in the first trial. Most of the 'responsive' dogs (14 out of 17) were responsive also in the re-testing ($p = 0.013$) in contrast to 'non-responsive' ones ($p = 0.508$), which changed their behaviour to 'responsive' in the re-test.

2.2.2. Consistency of dogs' responsiveness—delayed re-testing

Results showed a similar pattern when the repeated trial was conducted 6–24 months later. That is, all dogs in the first episode (friendly approach) of both trials showed Friendly/Passive behaviour towards the Stranger and majority of individuals (18 out of 23, 72.3%) were scored as 'responsive' in the first experimental trial. Interestingly, Delayed repetition group showed significant consistency in their responsiveness ($p = 0.011$). Within the group, subjects scored as 'responsive' in the first trial showed a significant tendency to display the same type of reaction towards the Stranger during the repeated trial ($p = 0.031$), and all ($N = 5$) but one 'non-responsive' dogs showed also consistent behaviour upon repetition. (However, it was impossible for the statistical analysis to yield $p < 0.05$ with so few subjects.)

In summary, we found that independently of the time elapsed between the repeated trials, most of the 'responsive' subjects (28 out of 35) displayed relevant behaviour change in response to the altering cues of the Stranger ($p = 0.001$). Such consistency in behaviour was lacking in 'non-responsive' individuals (7 subjects out of the 14 switched to responsive behaviour in the second trial, $p = 0.999$).

2.2.3. Analyzing the consistency of different response categories

When responding to the Stranger in the threatening approach episode dogs were assigned to one of the four categories (Friendly/Passive, Passive avoidant, Active avoidant, Threatening). Assuming that for an individual the probability value of exactly the same behaviour response

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Table 2
Cross-tabulation of the first and second test

1st test, Threatening approach	2nd test, Threatening approach				
	Friendly/Passive	Passive avoidant	Active avoidant	Threatening	p
Friendly/Passive	**7 (3 + 4)**	4 (4 + 0)	0	3 (2 + 1)	**0.038**
Passive avoidant	1 (1 + 0)	**0**	1 (0 + 1)	3 (1 + 2)	No stat
Active avoidant	2 (1 + 1)	2 (2 + 0)	**4 (2 + 2)**	3 (1 + 2)	0.287
Threatening	4 (1 + 3)	0	1 (0 + 1)	**14 (8 + 6)**	**<0.0001**

Results of the 'Immediate-'and 'Delayed re-test' groups. The number of dogs performing different responses in the first and second trials is indicated. The first numeral position in the bracket refers to the 'Immediate re-test' group whilst the second numeral indicates the number of dogs in the 'Delayed re-test' group. Cells indicating consistent behaviour are bold.
The levels of significance (p) are highlighted where dogs showed significant consistency in replicating their response towards the Stranger. p-Values were calculated by binomial tests.

is 1/4 we found a significant tendency to replicate the same behaviour towards the Stranger both in the 'Immediate repetition' (binomial test, $p = 0.003$; test proportion = 0.25) and 'Delayed repetition' ($p = 0.005$) groups. Consistency in dogs' behaviour towards the threatening Stranger was more significant when the two groups were analysed together (i.e. dogs tended to perform the same behaviour in the first and second trials; $p < 0.0001$). Importantly, however, when the dogs' willingness to replicate the behaviour performed in the first test was analysed separately in the four different response categories we found apparent differences (Table 2). Namely, whilst dogs showing either Threatening or Friendly/Passive behaviour in the second episode of the first trial towards the Stranger ($N = 19$ and 14, respectively) were disposed towards a consistent behaviour upon repeated trial ($p < 0.0001$ and $p = 0.038$), the number of dogs replicating the firstly shown behaviour in the Active avoidant category was at chance level ($p = 0.287$). Moreover, dogs which were categorized as Passive avoidant in the first trial showed a significant tendency to behave inconsistently in the repeated trial (none of the five Passive avoidant reactions in the first test proved to be consistent in the second trial, no statistics could be performed because of the few data points, Table 2).

2.2.4. Associations between questionnaire and behaviour observations

Regarding the distribution of 'responsive' vs. 'non-responsive' dogs there were no significant differences between different sexes ($\chi^2 = 0.82$, d.f. = 1, $p = 0.365$) and threatening behaviour towards Stranger was not more frequent among males than females ($\chi^2 = 1.24$, d.f. = 1, $p = 0.260$). Categorizing the dogs into three groups on the basis of their training qualification (untrained, basic obedience, special training) no effect was found on either responsiveness ($\chi^2 = 1.64$, d.f. = 2, $p = 0.440$) or on the frequency of acting threateningly towards the Stranger ($\chi^2 = 2.14$, d.f. = 2, $p = 0.352$).

Keeping conditions, however, had some significant effects on dogs' responsiveness ($\chi^2 = 3.99$, d.f. = 1, $p = 0.045$). Namely, the majority of dogs (92%) kept for special purposes (sport, guarding, etc.) showed situation relevant changes in their behaviour towards the Stranger approaching either friendly or threateningly. In contrast, many of the dogs (37.5%) kept for 'no reason' (pet dogs) continued to react to the Stranger in a Friendly/Passive way even when she changed her behaviour (from friendly to threatening). At the same time, purposeless vs. purposeful keeping conditions did not affect the probability of Threatening response towards the Stranger ($\chi^2 = 0.02$, d.f. = 1, $p = 0.893$).

Further, we could not find significant effect of the intensity of social contact with the owner (cumulative scores of Q3 & Q4) comparing either 'responsive' vs. 'non-responsive' dogs ($U = 196$, $p = 0.883$) or dogs categorized as Threatening vs. non-Threatening ($U = 216.5$, $p = 0.745$).

Finally, negative attitude toward unfamiliar humans (cumulative scores of Q5 & Q6) was different neither between 'responsive' and 'non-responsive' dogs ($U = 204$, $p = 0.930$) nor between the subjects showing Threatening vs. non-Threatening behaviour towards Stranger ($U = 243$, $p = 0.999$).

3. Study II

In the above experiment the stability of the dogs' reaction in the "approaching stranger" test was studied using the same woman. The identity of the human interactant, in turn, could be important in our case and in those studies, when behavioural testing is conducted on a large sample by many experimenters (see e.g. Svartberg, 2002; Svartberg et al., 2004). Earlier it has been shown that human gender influences certain elements of the dogs' response towards humans (e.g. Wells and Hepper, 1999), however, we could not find evidence regarding the consistency of dogs' reaction towards different persons, with similar main characteristics (gender, age, physical appearance).

This study, therefore, was designed to assess if in addition to the temporal consistency of the dogs' reaction to a given unfamiliar woman, the observed response is consistent across different women of similar age and physical appearance.

3.1. Methods

3.1.1. Subjects

Twenty adult family dogs (7 females, 13 males, mean age ± S.D.: 3.7 ± 3.04) participated in our study. They were from 10 different breeds (2 German Shepherd, 2 Briard, 2 English Cocker Spaniel, 2 Parson Russell Terrier, 1 Hovawart, 1 Wire-haired Hungarian Vizsla, 1 French Bulldog, 1 Golden Retriever, 1 Dachshund, 1 Airdale Terrier) and there were six mongrels. All dog owners were recruited on a voluntary basis.

3.1.2. Procedure

All dogs took part twice in the "approaching stranger experiment" using the same protocol as described in Study I. In this study, however, two different unfamiliar persons acted as the stranger. One of the strangers (Stranger 1) was the same person for each dog (she was the third author -B. Gy.: female, age: 27, height: 158 cm, weight: 56 kg). The other stranger (Stranger 2) was different for each dog, but the physical appearance of these second persons were similar to that of the first one (all of them were females, $N = 20$, age ± S.D.: 26 ± 5.02, height range: 155–170 cm, weight range: 55–65 kg). Before the experiment detailed verbal instructions were given to Stranger 2 and Stranger 1 also demonstrated for her how to perform the friendly and threatening approach episodes.

Observations took place at outdoor locations (near to a dog school or at common dog walking areas). During the tests only the owner of the dog, the Stranger 1, Stranger 2 and a cameraman were present.

The two tests with the different persons were conducted at the same place right after each other. The order of the two partners (Stranger 1 or Stranger 2) was counterbalanced across the dogs.

3.1.3. Data analysis

The reactions of the dogs were assigned into one of four categories (Threatening, Active avoidant, Passive avoidant, Friendly/Passive). The consistency of the dogs' reaction (as described in Study I) to the two different strangers was established both in the friendly and threatening approach episodes (consistency of friendly and consistency of threatening approach). Dogs showing the same response (e.g. Passive

avoidant) toward both strangers during the same part of the test situation were regarded as consistent. Additionally, dogs were labelled (as specified in Study I) as 'responsive' or 'non-responsive' towards the strangers, depending on whether they showed different response category when the stranger changed her behaviour from friendly to threatening.

We used the same analyses for the three consistency variables (consistency in friendly approach, in threatening approach and in responsiveness) as in Study I (binomial tests with the test proportion of 0.5 and 0.25).

To study the order effect we compared those dogs' reaction which were tested first by the Stranger 1 and then by Stranger 2 with subjects tested in the reversed order (Fisher exact test).

3.2. Results

3.2.1. Order effect of the two strangers' approaches

Looking for any effect of the testing order we compared the reactions of those dogs which were tested first by Stranger 1 with those dogs which were tested first by Stranger 2.

The reaction of the two groups of dogs did not differ significantly during the approaches of Stranger 1 (Fisher exact test: friendly approach: $p = 1.0$, $N = 20$; threatening approach: $p = 1.0$, $N = 20$), similarly to the approaches of Stranger 2 (friendly approach: $p = 0.474$, $N = 20$; threatening approach: $p = 1.0$, $N = 20$). When Stranger 1 approached in a friendly way all but one dog showed contact seeking-tolerating behaviour. However most of the dogs showed contact avoiding response (except one and two individuals in the two groups) during her threatening approach.

Results were similar during the approaches of Stranger 2. Two dogs' behaviour was contact-avoiding during the friendly approach whilst 8 and 10 individuals were contact-seeking in the group tested first with Stranger 2. The distribution of dogs' behavioural response was the same during the threatening approach of Stranger 2: two dogs were contact-seeking and eight dogs were contact-avoiding in each group. Taken together, the sequential order of the interacting persons (whether Stranger 1 or 2 approached the dog first) had no significant effect on the behaviour of dogs. Therefore the two groups are analysed as one sample hereinafter.

3.2.2. Consistency of responsiveness

Majority of dogs (16/20) showed the same response category towards the two unfamiliar strangers (binomial probability: $p = 0.012$). Fourteen of them were responsive in both cases, 2 of them showed a non-responsive reaction. Only four dogs showed changes in their responsiveness (all of them were responsive when tested with Stranger 1 and non-responsive when tested with Stranger 2). This means that the dogs' responsiveness to the behavioural cues of a stranger is consistent across different persons.

3.2.3. Consistency of the detailed behavioural categories

In the friendly approach episode 19 dogs out of 20 subjects showed consistent behaviour (binomial probability: $p < 0.0001$). 18 dogs reacted Friendly/Passively toward both strangers and 1 dog showed Passive avoidant response in both cases. Interestingly, only one individual proved to be inconsistently behaving: performing Friendly/Passive reaction to Stranger 1 and Passive avoidant reaction to Stranger 2. During the threatening approach episode 16 dogs reacted the same way (binomial probability for consistency: $p = 0.012$) showing either "Threatening" response ($N = 5$), Passive avoidance ($N = 8$) or Friendly/Passive reaction ($N = 3$) towards both human partners. Only four dogs responded to the two persons differently: 1-1 subjects showed

Active avoidance/Threatening, Passive avoidance/Threatening, Threatening/Active avoidance and Active avoidance/Friendly towards the Stranger 1 and Stranger 2 respectively.).

3.3. General discussion

Individual behavioural differences are well documented in dogs (e.g. Plutchnik, 1971; Goddard and Beilharz, 1985; Svartberg and Forkman, 2002). However, any of the characteristic traits can be regarded as the behavioural manifestation of individuality only if the observed trait is consistent and shows reliable stability over time.

The purpose of the present study was to establish the relevance of the procedure used by Vas et al. (2005) in testing the consistency of the dogs' response toward an unfamiliar human. Following the methodology suggested by others (e.g. Netto and Planta, 1997) a within-subjects design was used in order to analyse test–retest associations. Since the procedure was identical to that used in Vas et al. (2005) study we have analysed the behaviour of dogs on the basis of the same categorization as described there.

Regarding the question of whether an individual reacted flexibly to the sudden changes of human behaviour, dogs could have been categorized as either responsive or non-responsive. We have found that in the first experimental trial the majority of Belgian Shepherd dogs altered their behaviour in accordance with the switch in the Stranger's way of approach. Showing responsive behaviour proved to be a consistent characteristic of the individuals both when the trial was repeated immediately or few months later. Interestingly, however, consistency of the non-responsive behaviour was not so evident. Two-thirds of the non-responsive dogs (6/9) became responsive when the trial was repeated immediately after the first one whilst all but one subject (4/5) continued to behave in a non-responsive way towards the unfamiliar human when the repetition was conducted on average 1 year later.

Changes in the responsiveness of the subjects in the 'Immediate repetition' group could be due to the temporal effect of the repeatedly conducted trials. That is, in this case the longer duration of the Stranger–dog interaction and the repeatedly altering cues of the human (friendly-threatening then friendly-threatening) could sensitize the dogs leading to a stronger effect of evoking a relevant response (Passive/Active avoidance or Threatening) in the second threatening approach episode. We suggest, therefore, that the inconsistency of non-responsive behaviour in this group may be an inherent consequence of the experimental design. These results underline the importance of using both short and long between-test interval times in testing behaviour consistency.

Regarding the stability of the observed response in terms of the 4-categories (Friendly/ Passive, Active avoidant, Passive avoidant, Threatening) it is important to note that the observed consistency depended on the types of dogs' responses towards the unfamiliar human. Having been shown either a 'Threatening' or 'Friendly/Passive' behaviour dogs tended to perform the same behaviour upon the repeated trial whilst subjects categorized first as 'Active avoidant' have shown chance performance as regards their consistent response. However, none of the dogs classified as 'Passive avoidant' in the first trial showed the same behaviour in the second one suggesting that this response category cannot be regarded as a consistent trait.

This apparent heterogeneity of the test–retest stability of the four behaviour categories suggests that different responses can be regarded as different manifestations of the same continuum representing the fear/aggression or approach/avoidance (Schneirla, 1959) motivational conflicts. Accordingly, subjects showing a moderate (and/or ambivalent) behaviour (e.g. Passive avoidance) towards the threatening human are ready to switch to a more definite response

(Active avoidance or Threatening) upon repeated trials, whilst dogs performing an extreme of this continuum (Threatening or Friendly) are more consistent over time. Our analysis also points to the general problem, that the more fine decomposition of the behaviour we apply, the less we can identify the observed variables with consistent 'personality characteristics'.

Another important aspect of behaviour consistency is whether these behavioural traits are susceptible to environmental influences. Training experiences, the process of socialization and other environmental factors are often supposed to have an important effect on many individual characteristics such as aggressiveness (Podberscek and Serpell, 1997). Differences between the males' and females' aggressive behaviours have also been reported, and most researches found males to be more aggressive than females (e.g. Line and Voith, 1986, Lund et al., 1996, Serpell and Jagoe, 1995, Ruefenacht et al., 2002). However, some studies failed to show such an effect (Guy et al., 2001) and others argued that (aggressive) responses to an unfamiliar human show gender-specific differences only when the target person is a man (Lore and Eisenberg, 1986). In line with these later findings we found that males and females were similarly responsive towards the unfamiliar woman and there were no significant differences in the number of subjects showing aggression in Belgian Shepherds.

The crucial aspect of the present experimental situation was the exaggerated use of some social releasers (keeping eye contact, etc.) on the part of the human and the flexible switching in her behaviour cues of friendliness and threatening. Looking steadily in the eye of the dog, for example, is one of the behaviour cues provoking dominance aggression (e.g. Line and Voith, 1986; van der Borg et al., 1991; Serpell and Jagoe, 1995). Since dog trainers routinely utilize these behaviour cues in the course of training, we may assume that well trained dogs gain extensive experience on how to react to different signs of human behaviour. Interestingly, however, we did not find significant effects of training qualification on the dogs' consistent responsiveness and aggressiveness in the experimental situation which supports the dominant role of inherited temperament characteristics in the observed reaction.

Keeping conditions, however, seem to have an effect on the observed behaviour. Dogs living in companion relationship with the owner (compared to those who are in working relationship with the human) tended to maintain friendly behaviour even after the Stranger switched from displaying friendly cues to threatening ones. Companion vs. working relationship affect the dogs' interactions with humans in many ways as it was demonstrated in the case of attachment, problem solving behaviour (Topál et al., 1997) and the degree of excitement in different situations (Kobelt et al., 2003). Accordingly, we may assume that dogs living in a more intimate emotional relationship with their human family were probably less fearful towards the unfamiliar human and had more confidence in her even when she suddenly became threatening and/or used the owner as a secure base (Topál et al., 1998) in such controversial situation.

To our surprise, the owners' scoring on the dog's negative attitudes towards unfamiliar humans and the amount of daily social contact with the owner did not show significant associations with the observed behaviour performance in contrast to Jagoe and Serpell (1996), who found associations between time engaged in training and walking and aggression in English Cocker Spaniels. There were no more aggressively responding dogs (towards the threatening stranger) among subjects who were scored by the owner as aggressive/distrustful towards unfamiliar humans. These results are inconsistent with studies suggesting that dogs which spend more time together with the owner are less excited (Kobelt et al., 2003) and are less aggressive (Podberscek and Serpell, 1997) in unfamiliar situations. Our results suggest that owners were unable to give a reliable prediction on their dogs' behaviour towards the stranger showing altering cues (social releasers) of friendliness and threatening. This may have been so because the experimental

situation used here was unusual for the dogs (and the owners) as in everyday situations they probably never encounter a human showing such alternations in her behaviour. Similarly to our results others also failed to show significant associations between many of the behaviour traits in German Shepherds and the predictions (questionnaire data) given by the owners regarding those traits (Fuchs et al., 2005).

Being a valid and reliable procedure (Vas et al., 2005) we think that our 'approaching stranger' test could be a relevant part of a test battery measuring personality characteristics related to shyness/boldness dimension (for a similar case see the ''Social interaction'' and ''Ghosts'' subtest in Svartberg and Forkman, 2002 paper).

In sum, these results support the view that the 'Friendly/Threatening Stranger' paradigm is a relevant experimental approach for studying the dogs' responsiveness to social releasers provided by humans and the consistency of the observed behaviour traits can be associated with personality characteristics in dogs.

Acknowledgements

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