

Provided for non-commercial research and education use.  
Not for reproduction, distribution or commercial use.



This article appeared in a journal published by Elsevier. The attached copy is furnished to the author for internal non-commercial research and education use, including for instruction at the authors institution and sharing with colleagues.

Other uses, including reproduction and distribution, or selling or licensing copies, or posting to personal, institutional or third party websites are prohibited.

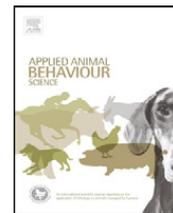
In most cases authors are permitted to post their version of the article (e.g. in Word or Tex form) to their personal website or institutional repository. Authors requiring further information regarding Elsevier's archiving and manuscript policies are encouraged to visit:

<http://www.elsevier.com/copyright>



Contents lists available at SciVerse ScienceDirect

# Applied Animal Behaviour Science

journal homepage: [www.elsevier.com/locate/applanim](http://www.elsevier.com/locate/applanim)

## Preliminary analysis of an adjective-based dog personality questionnaire developed to measure some aspects of personality in the domestic dog (*Canis familiaris*)

Erika Mirkó\*, Enikő Kubinyi, Márta Gácsi, Ádám Miklósi

Department of Ethology, Eötvös Loránd University, Budapest, Hungary

### ARTICLE INFO

#### Article history:

Accepted 12 February 2012

Available online 16 March 2012

#### Keywords:

Dog  
 Personality  
 Breed  
 Breed-group  
 Demography

### ABSTRACT

In this paper we present a novel adjective-based dog personality questionnaire, which was successfully implemented to characterise the behaviour of individual dogs. The scales obtained by Principal Component Analysis (Stranger-directed Sociability, Activity, Aggressiveness and Trainability) correspond well with the results of other studies published earlier. The obtained personality scales were also used to compare breed-groups registered in Fédération Cynologique Internationale (FCI) and a distinct group of mongrels was also included in the total sample ( $N=352$  dogs). Results suggest that in the case of pet dogs there are only slight detectable differences in personality dimensions between breed-groups and breeds. Furthermore, the present investigation also includes the comparison of two breeds, the Hungarian Vizsla and the German Shepherd Dog. After matching for demographic differences, we could not reveal differences in personality traits between the two breeds kept as pets. These observations caution against making hasty claims about the presence or absence of breed differences because environmental factors can mask, or even enhance potentially existing genetically potentiated breed differences.

© 2012 Elsevier B.V. All rights reserved.

### 1. Introduction

The study of dog personality has attracted a lot of attention in the past few decades. Personality can be defined as the characteristics of adult individuals which describe and account for consistent patterns of behaving, feeling and thinking (e.g. Jones and Gosling, 2005).

In the case of dogs (*Canis familiaris*) one commonly used assessment method is the behavioural test battery (Jones and Gosling, 2005), where during a test situation the dogs' reactions to specific stimuli are documented and coded (e.g. Netto and Planta, 1997; Serpell and Hsu, 2005; Hsu and Serpell, 2003; Svartberg and Forkman,

2002; Svartberg, 2002, 2005). *Ad hoc* observational tests are also carried out, in which dogs are scored for their reactions to uncontrolled, naturally occurring stimuli like the ones they encounter while walking through e.g. a shopping area (Goddard and Beilharz, 1984). This method is used to depict broad traits recognisable in naturalistic environments and, in this way, allows general conclusions about the dogs' temperaments and behavioural patterns (Goddard and Beilharz, 1984; Murphy, 1995, 1998; Jones and Gosling, 2005). Finally, another common means of assessment is the rating of individual dogs, for which an informant, usually the owner, provides information regarding a particular dog's behaviour (e.g. Jones and Gosling, 2005; Sheppard and Mills, 2002; Svartberg, 2005). In this regard 'behaviour' (or behaviour element, see also ethogram) refers to an action that can be described in terms of limb and/or body movement, orientation and location (e.g. Martin and Bateson, 2007).

\* Corresponding author.

E-mail address: [erika.mirko@gmail.com](mailto:erika.mirko@gmail.com) (E. Mirkó).

For the description of the 'whole' personality the units of the test battery must simulate a large number of situations including stimulations by novel stimuli. This, however, inevitably brings about the problem that a test battery cannot be extended without limitations, since no dog can be expected to give the same reactions over a long period of time, and, in turn, the range of the behaviour displayed is rather constrained by the inescapably limited number of test units. Furthermore, the possibility that the subject's inner state, and as a consequence, its behaviour will change during the course of the test situations cannot be excluded either.

In contrast, behavioural ratings of individual dogs by respondents may appear to be a rather subjective way of assessment (e.g. Vazire et al., 2007). However, many years of research has indicated that data gathered by means of questionnaires can be accurate and consistent in evaluating individual dogs for various behavioural traits (e.g. Gosling et al., 2003). In this respect 'behavioural trait' is a word which describes differences among individuals broadly (McCrae and John, 1992). The term 'friendly', for example, is a behavioural trait. Personality dimensions, which have been set up on the basis of test batteries and questionnaire studies depend heavily on the content of the assessment tool applied. As a result, the dimensions identified show a great diversity both in number and in the behaviour variables ('items') constituting them (e.g. Hsu and Serpell, 2003; Serpell and Hsu, 2005; Svartberg, 2002, 2005; Gosling et al., 2003). No model has been established with the potential to serve as a common organizing framework in the field of canine personality research (Jones and Gosling, 2005).

In human personality research, the so-called Five Factor Model (FFM) has been found to be one of the most useful organizing structures attempting to depict some aspects of personality (Goldberg, 1993; McCrae and John, 1992; Digman, 1990; Tupes and Cristal, 1992). In a review Gosling and John (1999) applied this model to characterise animal personality where they compared personality structures of 12 species including dogs. Gosling et al. (2003) further examined whether canine personality dimensions represent analogues of the human FFM factors. In order to test this, he used the Big Five Inventory. The wording of four original FFM scales was altered to make them suit dogs' behaviour and the Consciousness scale was omitted. Their adjusted questionnaire was filled in by the owners of 78 dogs, half of which were mongrels. The scales established were Energy as the analogue of human Extraversion, Affection as the analogue of the human Agreeableness, Emotional Reactivity for the human Neuroticism and Intelligence for the human Openness/Intellect. Kubinyi et al. (2009) established similar scales on the basis of a shorter version of the human FFM (24 questions only). On a large sample of dogs (more than 14,000 individuals) they developed four personality scales: calmness, trainability, dog sociability and boldness. Ley et al. (2008) used a 67 item questionnaire based on dog specific adjectives like 'non-aggressive' or 'trainable' to contribute to the identification of dog personality. Five personality dimensions were identified: extraversion, self-assuredness/motivation, training focus, amicability and neuroticism (Ley et al., 2008).

Despite the interest in deriving breed specific "personality-like" profiles neither of the studies above compared the breeds in terms of these specific scales. Such comparisons could be revealing because it is not clear how genetic and environmental factors contribute to behavioural variations among breeds. The behaviours under past selection are no longer regarded prominent in the breed standards today (McGreevy and Nicholas, 1999). The differences in individual dogs' behaviour within a breed may exceed variations among breeds (Hart and Miller, 1985), therefore an individual-based analysis has become remarkably essential in order to unveil whether a given behavioural trait differentiates not only individual dogs but also a greater number of dogs belonging to a particular breed or breed group. Observing a range of dog breeds in a behavioural test battery Svartberg (2006) did not find support for breed-group differences in certain personality dimensions. The use of modified human FFM for dogs may not be advantageous because it lacks dog specific questions. For example, FFM does not distinguish between intra- and inter-specific aggression which is not an issue in humans but which is a very important aspect of a dog's life.

In this study we used a different method by collecting dog specific questionnaire items from people who lived with or trained dogs (see Section 2). The present questionnaire was biased towards using adjectives (with explanations) which may have the potential to grasp some of the behaviour traits of the dog at a more global level (*in sensu* McCrae and John, 1992, see above) (see Appendix VI). There is also evidence that human observers are able to judge the behaviour of animals using their own terminology, mainly referring to behaviour in terms of adjectives (Wemelsfelder et al., 2000; see also Gosling, 1998).

The questionnaire was filled in by owners of pet dogs with varied demographic backgrounds. In addition, all the ten Fédération Cynologique Internationale (FCI) breed groups, plus a group of mongrels, are represented in the sample balanced in number with regard to the number of breeds comprising the particular breed group.

We had two main aims. The first aim was to provide some ways of internal and external validation for the personality dimensions obtained by our questionnaire. Secondly, we wanted to compare two popular breeds in Hungary. Our choice fell upon the comparison of the German Shepherd Dog and the Hungarian Vizsla because the ancestors of the former breed were originally bred for herding sheep, the latter was used as a gun dog. These different breed-typical tasks required inevitably different skills, and as a consequence, detectable differences in personality can be expected between the two populations. Moreover, in our modern society, where the focus of breeding has witnessed a number of changes (McGreevy and Nicholas, 1999; Svartberg, 2006), the difference between these two breeds with regard to function is still there. While the German Shepherd Dog has become a preferable breed for police and border guard purposes and less favoured as a pet (Miklósi, 2007), the Hungarian Vizsla is a popular family dog (Gottlieb, 2002).

## 2. Methods

### 2.1. Subjects

#### 2.1.1. Dogs representing the 10 FCI groups and mongrels

The dogs and their owners were recruited on voluntary basis from dog training schools, dog-shows, among the participants of our Family Dog Research Database and from different parts of the country reacting to our notice in the Hungarian edition of *International Dog Magazine* calling for dog keepers to fill in our Dog Personality Questionnaire. The questionnaire data were recorded from 395 participants between January 2005 and June 2008, but 43 were incomplete and were excluded from the analysis. The ultimate sample consisted of 284 animals of the 10 FCI breed groups, balanced in number for all the groups with regard to how many breeds are registered under a particular FCI category and sixty-eight mongrels were also added to the sample (for more details see [Appendix I](#)). In order to avoid overrepresentation on the part of any of the breeds, maximum 8 dogs were included from any of the breeds. 189 of the dogs (54%) were males and 163 (46%) were females. In terms of their age, the dogs were assigned to three classes: young dogs (subjects of 1–3 years old  $M=1.90$ ,  $SD=0.72$ ;  $N=190$ ), mature dogs (subjects of 3.5–7 years old  $M=5.03$ ,  $SD=1.06$ ;  $N=112$ ), old dogs (subjects of 7.5–17.5 years old  $M=9.68$ ,  $SD=2.20$ ;  $N=50$ ). The classifications were based on previous studies examining the signs of aging in dogs (e.g. [Golini et al., 2009](#)) and the effect of aging on the personality dimensions of dogs established by [Kubinyi et al. \(2009\)](#). One hundred and twenty dogs of the 352 (34%) spent most of their time in a flat, 125 (35.5%) both in the flat and in the garden while 81 dogs (23%) were kept in the garden, 26 (7.5%) in a kennel. 141 of them (40%) were trained and 211 (60%) untrained. The dogs were also categorised into four weight groups on the basis of veterinary weight classifications. Group one involved dogs who were 10 or under 10 kg. Sixty-five dogs (18.5%) of the whole sample belonged to this category. Group two comprised the ones weighing between 11 and 25 kg with 90 dogs (25.5%) in it. Group three was formed with 107 dogs (30%) weighing between 26 and 44 kg while group four contained 22 dogs 6% weighing 45 kg or above. We had no data about the 68 mongrels (19%) of the total number of subjects. The demographic data of the owners together with some additional independent variables can be found in [Appendix II](#).

#### 2.1.2. The Hungarian Vizsla and the German Shepherd Dog

We had collected questionnaires of thirty-six Hungarian Vizslas and fifty-five German Shepherd Dogs. Twenty of the Hungarian Vizslas (55.5%) were males and 16 (44.5%) were females. In terms of their age, the Hungarian Vizslas were also assigned to three classes: young dogs (subjects of 1–3 years old  $M=1.60$ ,  $SD=0.60$ ;  $N=16$ ), mature dogs (subjects of 3.5–7 years old  $M=5.06$ ,  $SD=1.01$ ;  $N=15$ ), older dogs (subjects of 7.5–17.5 years old  $M=8.60$ ,  $SD=0.82$ ;  $N=5$ ). As regard their housing conditions, 11 dogs of the 36 (31%) spent most of their time in a flat, 20 (55.5%) both in the flat and in the garden while 5 dogs (13.5%) were kept in the garden. 18 of them (50%) were trained and 18 (50%)

untrained. As regard the German Shepherd Dogs, 24 (44%) were males and 31 (56%) were females. Their representation in the above mentioned three age groups: young dogs (subjects of 1–3 years old  $M=1.77$ ,  $SD=0.84$ ;  $N=28$ ), mature dogs (subjects of 3.5–7 years old  $M=5.10$ ,  $SD=1.23$ ;  $N=20$ ), older dogs (subjects of 7.5–17.5 years old  $M=9.93$ ,  $SD=1.17$ ;  $N=7$ ). Eight dogs (14.5%) of the 55 spent most of their time in a flat, 20 (36%) both in the flat and in the garden while 17 (31%) dogs were kept in the garden and 10 (18%) in a kennel. Thirty two of them (58%) were trained and 23 (42%) untrained. The data regarding the owners together with other independent variables are in [Appendix III](#).

When investigating further, we matched the two breeds according to demographic variables (dogs' sex, age group, housing conditions, training background, owner's sex, owner's age, owner's educational background, the amount of time the owner spends with the dog, the owner's opinion about the dog's human speech comprehension) as much as we could. For further details see [Appendices IV and V](#).

### 2.2. Development of the questionnaire

The item generation process had three phases. First, a dog expert with over 25 years of experience including obedience, agility and assistance dog training with a large number of breeds and with experience in breeding Tervueren dogs, two breeders breeding German and Belgian Shepherd Dogs (both Tervueren and Malinois) and five dog owners with at least eight years of experience with a wide range of breeds were asked to write a list of behavioural traits of dogs on their own on a blank sheet of paper. On the basis of their observations the list contained items like 'brave', 'sensitive', 'aggressive towards stranger', etc. In this way, eight lists of traits were written altogether, one by our dog expert, two by the two breeders and five by the five dog owners. The eight lists contained a total number of 411 items.

In the second phase the eight lists were compared and the overlapping items were grouped. From each group the one considered to be the most concise, the most telling and the easiest to understand was retained. The selection was made by the first author (E.M.) and the collaborating expert, the third author (M.G.) together. In this way, 78 items were kept.

The last phase was also carried out by the two authors named above. During this phase the remaining set of features was reconsidered, the items conveying similar meanings grouped again and the ones which we considered to capture dog personality in the most telling way were retained. After this third phase the final version of the Dog Personality Questionnaire contained 38 items with concise examples for each one with a 5-point frequency Likert scale (ranging from 'not typical at all' (1) to 'absolutely typical' (5)). Data were also collected regarding the owner's age and educational background as well as what he/she thinks about the cognitive abilities of dogs in general. With the question "To what extent do you think your dog understands human speech?" we aimed to learn about the owner's anthropomorphic attitude toward the dog.

**Table 1**

Factorial structure, loadings of items, eigenvalues of factors, explained variance, and theta. Note that only 55% of the original items of the questionnaire could be retained for the analysis.

Factorial structure				
Variables	Stranger-directed Soc	Activity	Aggressiveness	Trainability
Brave	<b>0.65</b>	−0.07	0.15	0.34
Afraid of noises	−0.55	−0.07	0.02	−0.01
Mistrustful	<b>−0.74</b>	−0.03	0.27	−0.01
Initiative	<b>0.68</b>	−0.01	−0.04	−0.07
Lazy	0.14	<b>−0.57</b>	0.07	−0.08
Likes apportioning	0.10	<b>0.72</b>	−0.10	0.12
Likes games of fight	0.01	<b>0.54</b>	0.09	0.07
Overactive	0.14	<b>0.70</b>	0.21	−0.12
Likely to bite a human	−0.07	−0.15	<b>0.64</b>	0.08
Jealous of dogs	0.02	−0.01	<b>0.58</b>	0.07
Hysterical	0.08	−0.05	<b>0.50</b>	−0.38
Barks	−0.24	0.25	<b>0.58</b>	−0.02
Retaliative	−0.05	0.31	<b>0.56</b>	−0.16
Learns things easily	0.20	0.17	−0.01	<b>0.67</b>
Pleases the owner	0.04	0.16	0.07	<b>0.46</b>
Controllable	−0.09	−0.05	0.04	<b>0.66</b>
Disorganised	−0.02	0.10	0.22	<b>−0.65</b>
Eigenvalues	1.91	1.88	1.87	1.86
Explained variance	11.26%	11.09%	10.99%	10.98%
Theta	0.90	0.90	0.90	0.90

### 2.3. Data analysis

Principal Component Analysis was applied to explore the factorial structure of the questionnaire scores with Varimax rotation. The internal consistency of the questionnaire was estimated by the calculation of Theta (Armor, 1974), which is a more reliable method for the calculation of scale reliability than Cronbach's alpha (see also <http://psycho.unideb.hu/statisztika/pages/p.2.10.xml>). Spearman's correlation coefficient was calculated for investigating the discriminant validity of the personality factors. In order to analyse external consistency (the effect of age, gender, etc.) one-way ANOVA and *post hoc* test was done with Tukey pairwise comparison. We calculated the factor scores of the Hungarian Vizslas and the German Shepherd Dogs by adding their data one by one to the sample containing the data of the 352 dogs and reran the Principal Component Analysis. In order to compare the effect of training background and also to reveal whether there is a statistically significant difference between the factor scores of the personality dimensions of the Hungarian Vizsla and the German Shepherd Dog, independent-sample *t*-tests were also implemented. For the statistical analysis the SPSS statistical program (version 13.0) was used. The significance level of *post hoc* tests was set at  $p < 0.05$ .

## 3. Results

### 3.1. Investigation of internal validity

Principal Component Analysis was used to examine the factorial structure of the questionnaire scores. First, however, the median of the items was examined. Seventeen of the 38 items, of which the median was above 4 or less than 2, were excluded from further analysis (for

more details see Appendix VI). The remaining 21 were grouped into four factors following the guidelines drawn up by Tabachnick and Fidell (2001), that is, only those variables were retained that had 0.4 or greater loading on a particular factor. The four factors (*Stranger-directed Sociability*, *Activity*, *Aggressiveness*, *Trainability*) accounted for 44.32% of the total variance in nearly equal portions (see Table 1). The variables discarded either did not reach the threshold or they had high loadings on other factors. The convergent validity of all the four factors was satisfactory because all theta values were 0.90. Usually, values above 0.7 are regarded desirable (Armor, 1974).

In order to investigate discriminant validity, that is, whether the four factors are independent from each other we correlated the factor scores of all the four factors. Spearman's correlation coefficient was low, suggesting only weak association among the personality dimensions (Table 2).

### 3.2. Investigation of external validity

In order to test the external validity of the questionnaire, group comparisons were planned to analyse the effect of the dogs' age, sex, weight and training background on the scores of the four factors. The effect of the owners' sex, age, educational background and attitude towards their dog was also examined as well as the variables regarding the dog-owner interaction. Only 7.5% of the dogs were kept in a kennel, thus this category was excluded from this analysis. For the same reason, dogs weighing over 45 kg, owners between the age of 14 and 18 and owners finishing only Elementary School were excluded from the investigation of external validity.

In the case of *Stranger-directed Sociability*, we found significant association with the length of time pet and owner

**Table 2**

Correlations between the four personality factors (Sperman's rho). In the present analysis the factor variables did not correlate.

	Activity	Aggressiveness	Trainability
Stranger-directed sociability	-0.011	0.019	-0.026
Activity	-	-0.043	0.005
Aggressiveness		-	0.006

spent together  $F(3, 349) = 2.89$   $p = 0.036$ . The more daily interaction they had, the higher the dogs were scored on this personality factor.

In the case of the *Activity*, we revealed statistically significant divergence in the dogs' activity scores  $F(2, 320) = 5.38$  ( $p = 0.005$ ). The highest values appeared in young dogs (1–3 years old) somewhat decreased in mature dogs (3.5–7 years old) and were the lowest in older dogs (7.5–17.5 years old). A significant difference was also discovered between dogs belonging to different weight groups  $F(2, 318) = 2.89$  ( $p = 0.001$ ). Dogs weighing under 10 kg were reported the most active, while those weighing 45 kg or above the least active. Housing condition was found to affect activity level, that is, dogs living in flats were reported to be the most active, while those living in a yard scored the lowest  $F(2, 301) = 11.89$  ( $p = 0.001$ ).

We found that dogs taking part in organised training were characterised as being more *aggressive* than untrained ones ( $t(349) = 3.90$ ,  $p = 0.001$ ). Furthermore, dogs considered to understand intonations only were rated more aggressive than the ones which were believed to understand words or sentences whereas owners considering that their dog understands quite well what people are talking about rated their dog the least aggressive  $F(3, 334) = 2.82$  ( $p = 0.022$ ). Besides the effect of the training background, a statistically significant relationship was revealed between weight and aggression. Those weighing between 26 and 44 kg received the highest scores on *Aggressiveness* while those between 11 and 25 kg were assessed the lowest  $F(2, 346) = 4.48$  ( $p = 0.001$ ).

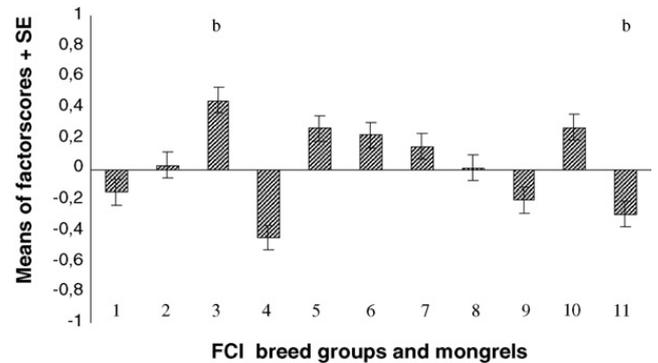
Dogs having taken part in organised trainings also got higher scores on *Trainability* than their non-trained conspecifics ( $t(349) = 3.954$ ,  $p = 0.001$ ), and dogs that were reported to understand human speech quite well were rated high on the factor *Trainability*  $F(3, 294) = 3.66$  ( $p = 0.003$ ).

**3.3. FCI breed group differences**

The breed groups showed significant variation in *Stranger-directed Sociability* ( $F(10, 342) = 2.17$   $p < 0.05$ ). Surprisingly, Tukey *post hoc* analysis found terriers more sociable than mongrels ( $p = 0.019$ ) (Fig. 1). Regarding the *Aggressiveness* no statistically significant difference could be detected among the eleven groups of pet dogs (Fig. 3).

Significant variations were found in *Activity* ( $F(10, 342) = 2.41$   $p < 0.05$ ). Tukey *post hoc* test found Sheep- and Cattle Dogs and Terriers more active than Sighthounds  $p = 0.009$  (Fig. 2).

*Trainability* showed significant variation among the breed groups ( $F(10, 341) = 2.19$ ,  $p < 0.05$ ), Tukey *post hoc* test found Retrievers – Flushing Dogs – Water Dogs less trainable than mongrels  $p = 0.018$  (Fig. 4).

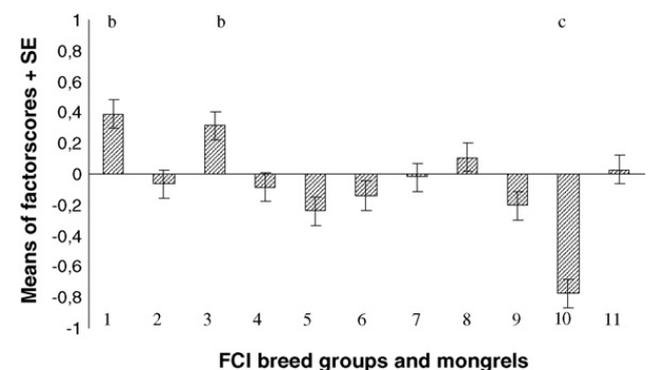


**Fig. 1.** The means and SE of factor scores in the ten FCI breedgroups and mongrels for *Stranger-directed Sociability*. (1) Sheep- and Cattle Dogs, (2) Molossoids, (3) Terriers, (4) Dachshunds, (5) Spitz and Primitive Types, (6) Scenthounds, (7) Pointing Dogs, (8) Flushing- and Water Dogs, (9) Companion and Toy Dogs, (10) Sighthounds, and (11) Mongrels. The population means is zero. Groups marked with 'b' differ significantly from each other ( $p < 0.05$ ). The population means is zero.

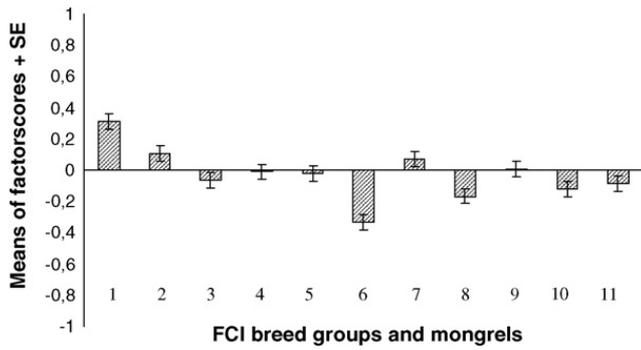
**3.4. Comparison of the Hungarian Vizsla and the German Shepherd Dog**

In the case of *Stranger-directed Sociability* and *Activity* the means of factor scores in both breeds were around the population means. However, in the case of *Aggressiveness*, the Hungarian Vizsla was found to have significantly lower scores than the German Shepherd Dog ( $t(89) = -0.24$ ,  $p = 0.04$ ). We had the same finding with *Trainability* as well ( $t(89) = -5.97$ ,  $p = 0.001$ ) (Fig. 5a).

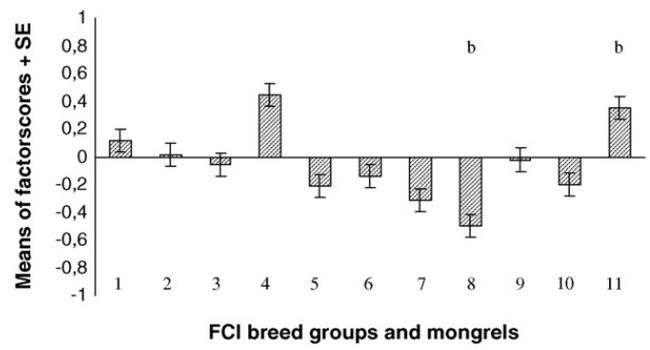
Since we wanted to find out whether the difference between the two breeds in the personality dimensions *Aggressiveness* and *Trainability* was due to the different



**Fig. 2.** The means and SE of factor scores in the ten FCI breedgroups and mongrels for *Activity*. (1) Sheep- and Cattle Dogs, (2) Molossoids, (3) Terriers, (4) Dachshunds, (5) Spitz and Primitive Types, (6) Scenthounds, (7) Pointing Dogs, (8) Flushing- and Water Dogs, (9) Companion and Toy Dogs, (10) Sighthounds, and (11) Mongrels. Groups marked with 'b' differ significantly from each other ( $p < 0.05$ ). The population means is zero. Groups marked with 'b' differ significantly from groups marked with 'a' ( $p < 0.05$ ). The population means is zero.



**Fig. 3.** The means and SE of factor scores in the ten FCI breedgroups and mongrels for in *Aggressiveness*. (1) Sheep- and Cattle Dogs, (2) Molossoids, (3) Terriers, (4) Dachshunds, (5) Spitz and Primitive Types, (6) Scenthounds, (7) Pointing Dogs, (8) Flushing- and Water Dogs, (9) Companion and Toy Dogs, (10) Sighthounds, and (11) Mongrels. There are no significant differences between the breed groups. There are no group differences. The population means is zero.

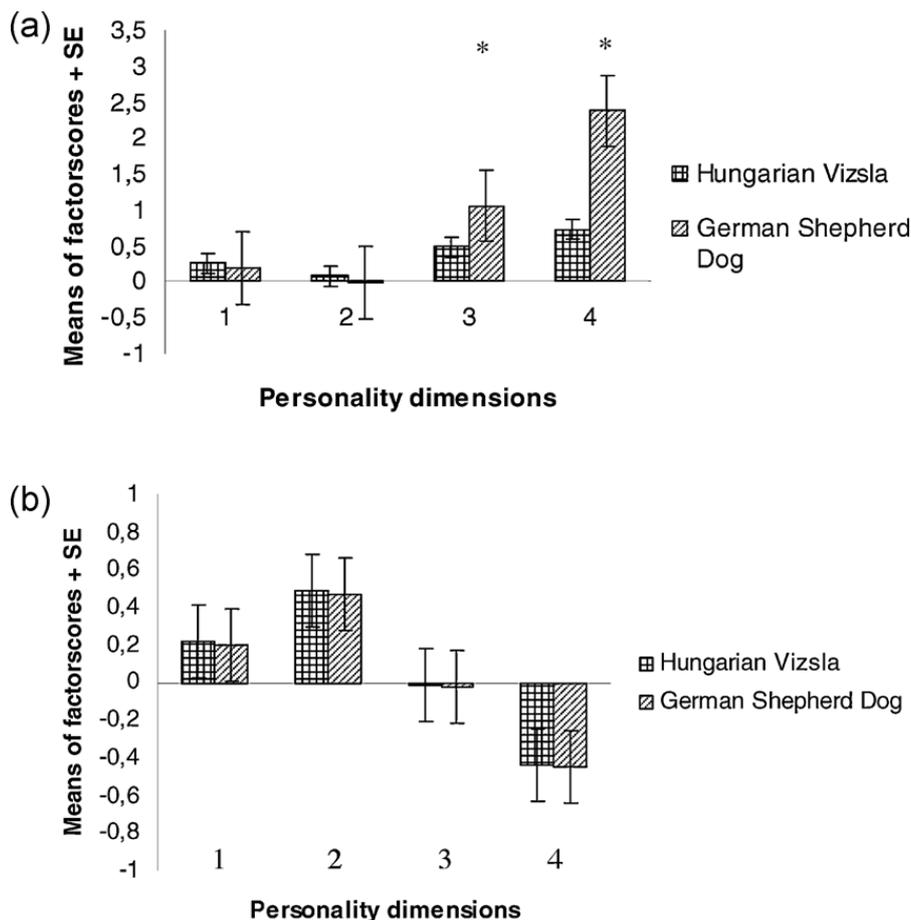


**Fig. 4.** The means and SE of factor scores in the ten FCI breedgroups and mongrels for *Trainability*. (1) Sheep- and Cattle Dogs, (2) Molossoids, (3) Terriers, (4) Dachshunds, (5) Spitz and Primitive Types, (6) Scenthounds, (7) Pointing Dogs, (8) Flushing- and Water Dogs, (9) Companion and Toy Dogs, (10) Sighthounds, and (11) Mongrels. Groups marked with 'b' differ significantly from each other ( $p < 0.05$ ). The population means is zero.

functions these two breeds were originally bred for, or the result is due to the variations in the demographic variables, we matched the data for the two breeds for as many demographic variables as possible and reran the analysis. In this case we had thirty-six dogs in both the Hungarian Vizsla and the German Shepherd Dog sample (for further details

see [Appendices IV and V](#)) and did not find any significant differences between the personality dimensions of the two breeds ([Fig. 5b](#)).

In order to unveil the underlying factors causing the difference in the first analysis, we examined the potential influences of the independent variables on the factor scores of the German Shepherd Dog group. We found,



**Fig. 5.** (a). The means and SE of factor scores of personality traits in Hungarian Vizsla and German Shepherd Dog. (1) *Stranger-directed Sociability*, (2) *Activity*, (3) *Aggressiveness*, (4) *Trainability*. \*Significant difference ( $p < 0.05$ ). (b) The means and SE of factor scores in the personality traits of Hungarian Vizsla and German Shepherd Dog based on matched groups. (1) *Stranger-directed Sociability*, (2) *Activity*, (3) *Aggressiveness*, and (4) *Trainability*. Note the scaling difference.

that in this breed housing condition had a statistically significant effect both on the factor *Aggressiveness* ( $F(3, 98) = 3.73, p = 0.02$ ) and *Trainability* ( $F(3, 52) = 3.30, p = 0.03$ ). *Post hoc* test revealed that dogs living in flats were rated the least aggressive while the ones living in a garden the most aggressive. Also, dogs spending most of their time both in the flat and in the garden were significantly more aggressive than those spending most of their time in the garden only. No interaction was found between any of the independent variables. In the case of *Trainability post hoc* test revealed that dogs living in flats were rated the least trainable while those which lived both in the flat and in the garden were the most trainable. No interaction was found between any of the independent variables.

#### 4. Discussion

In this study we applied an adjective-based dog personality questionnaire developed to measure the personality factors of pet dogs. The dogs were evaluated by their owners and the primary aim of the study was to determine the validity of this questionnaire. Many years of research have proven that data gathered by means of questionnaires can be accurate and consistent in evaluating individual dogs for various behavioural traits (e.g. Gosling et al., 2003; Jones and Gosling, 2005).

##### 4.1. Internal validity

We have investigated construct validity using both internal and external validation. The PCA extracted four factors (*Stranger-directed Sociability*, *Activity*, *Aggressiveness* and *Trainability*) and subsequent analysis showed good internal consistency suggesting that each item is a relevant and important part of its scale. A correlation analysis confirmed that our factors can be regarded as unrelated dimensions of dog personality. Despite the fact that both individually and in total the extracted factors explain only about 40% of the variance, all of them appear consistent with previous research on dog personality (see Gosling et al., 2003; Hsu and Serpell, 2003; Kubinyi et al., 2009; Svartberg and Forkman, 2002; Ley et al., 2008; Jones and Gosling, 2005). It is important to stress that the naming of the personality dimensions is often arbitrary, and thus any comparison on the basis of the dimension labels could be misleading. So any comparative analysis should also refer to the behaviour items which constitute those factors. Indeed, such an analysis in the present case results in surprising analogies at the level of factor labels.

Gosling et al. (2003) suggested that a four-dimensional model based on the human Big Five Inventory captures most the personality factors in dogs. 'Energy' is comparable to human 'Extraversion' comprising behaviour traits like 'active', 'likes excitement', 'not reserved', 'not shy' (Costa and McCrae, 1992) thus it is analogous to our *Activity*. 'Affection' the analogue of human 'Agreeableness', covering behaviour traits similar to the ones loading on our *Trainability* like 'tender-minded' and 'cooperative' (Costa and McCrae, 1992), 'Emotional Reactivity', analogous to human 'Neuroticism' of which behaviour traits are, for example, 'anxious', 'hostile', 'vulnerable to stress', 'fearful' and 'angry'

(Costa and McCrae, 1992), thus very similar to our *Aggressiveness* and finally 'Intelligence', the analogue of human 'Openness/Intellect' of which behaviour traits correspond to our *Stranger-directed Sociability*, since it includes traits like 'curious' 'open to experiences' 'does not mind the unfamiliar' (Costa and McCrae, 1992). Kubinyi et al. (2009) also employed a 24-item human personality inventory as a tool for establishing a model for dog personality factors and, similarly to Gosling et al. (2003), extracted four factors labelled 'Calmness' analogous to our *Activity*, 'Trainability' similar to our *Trainability*, 'Dog sociability' corresponding to our *Stranger-directed Sociability* and 'Boldness' which again, including the variables 'reserved', 'aloof' and 'fearful' parallels to our 'brave', 'initiative' and 'mistrustful' loading high (the last one negatively) on our *Stranger-directed Sociability*. Kubinyi et al. (2009) did not distinguish a separate factor for dog aggression, which is due to the fact that the human Big Five Inventory does not differentiate between intra- and interspecific aggression.

Hsu and Serpell (2003) used a 152 item questionnaire which aimed to collect information about how dogs responded to certain events and situations in their natural environment. In this way they established 11 factors which constitute segments of broader terms like aggression or sociability. The analysis of the factor loadings revealed that the variables loading strongly on Hsu and Serpell's 'Stranger-directed fear', 'Nonsocial fear' and 'Pain sensitivity' are analogous to the ones having high loadings on our *Stranger-directed Sociability*, since their variables loading strongly on their factors describe the dogs' anxious and fearful behaviour when being in interaction with humans or being exposed to different noises. Similarly, the items loading high on their 'Stranger-directed aggression', 'Owner-directed aggression', 'Dog-directed fear or aggression', 'Separation-related behaviour' and 'Excitability' correspond to the ones loading high on our *Aggressiveness*. Finally, their 'Attachment or attention-seeking behaviour' and 'Trainability' together capture what we call *Trainability*. However, Hsu and Serpell (2003) did not extract any factors describing the activity level of dogs simply because no variables were included measuring this factor.

Svartberg and Forkman (2002) revealed five personality factors on the basis of their behavioural test battery. It seems that their 'Playfulness' and 'Chase-proneness' correspond to our *Activity*, and 'Curiosity/Fearlessness' and 'Sociability' is similar to our *Stranger-directed Sociability*. Finally, 'Aggressiveness' is analogous to our *Aggressiveness*. However, no factor was extracted which corresponds to our 'Trainability' trait probably because they did not include a sub-test which may have provided a context for measuring trainability.

Ley et al. (2008) used a 67 item questionnaire containing dog specific adjectives and established five personality factors. Their 'Extraversion' corresponds to our *Activity*, which analogue could be detected in the study of Gosling et al. (2003) as well. 'Self-assuredness/Motivation' and 'Training Focus' is analogous to our *Trainability*. The variables loading strongly on their 'Amicability' capture a similar construct as our *Aggressiveness*, however, with adjectives expressing the opposite of those our *Aggressiveness* comprises.

Their 'Neuroticism' including the items 'nervous', 'fearful', 'timid', 'cautious', 'submissive' and 'sensitive' is the converse of our *Stranger-directed Sociability* including terms 'brave' and 'initiative' with positive while 'afraid of noises' and 'mistrustful' with negative loadings.

Jones and Gosling (2005) conducted a meta-analysis on a great number of empirical studies on the basis of which seven personality dimensions were extrapolated: 'reactivity', 'fearfulness', 'activity', 'sociability', 'responsiveness to training', 'submissiveness' and 'aggression'. Our four dimensions fit well into their framework and even the labels of their factors 'activity', 'sociability', 'responsiveness to training' and 'aggression' are almost the same as ours. Although we did not identify 'reactivity', 'fearfulness' and 'submissiveness' as a distinct dimension, some items in our *Aggressiveness* like 'jealous of dogs' or 'hysterical' are reactivity-related, 'brave' and 'afraid of noises' on our *Stranger-directed Sociability* are fearfulness-related, and the question whether activity and submission should be considered a separate personality factor or not has not yet been answered (Gosling and John, 1999; Jones and Gosling, 2005). The reason why 'reactivity', 'fearfulness' and 'submissiveness' were established as independent dimensions by these authors may lie in the fact that their review merged the results of test batteries, questionnaire studies, expert ratings of breeds and observational tests but not by doing statistical analysis based on correlations but by item classification made by a panel of expert judges (Jones and Gosling, 2005). As the authors noted themselves, their results may have been influenced by the idiosyncrasy of the collaborating judges (Jones and Gosling, 2005).

In summary we can say that previous personality studies regardless of methodology, although limited by their structure in identifying certain personality dimensions, established factors analogous to our personality factors. It suggests that our study is most likely to be a valid representation of personality factors in dogs, that is, the questionnaire items loading high on our factors were, properly chosen to capture the personality traits of dogs, and hint that the established factors must be evolutionary stable facets of dog personality. Nevertheless, the large number of papers published on dog personality recently relying on diverse methodology (even if using questionnaires) call for a more standardised application before more specific hypotheses could be formulated.

#### 4.2. External validity

When analysing the potential associations between the demographic variables and the factor scores the dogs had on each personality dimension we found that the more daily interaction dog and owner had, the higher the dogs scored on our factor *Stranger-directed Sociability*. In previous experiments significant association was revealed between dogs' friendliness with strangers and the time ratio a dog spent with its owner a day in active interaction. For example, Kubinyi et al. (2009) found that more frequent playing with the dog was related to higher scores on the "sociability" scale. Kobelt et al. (2003) found that excitability correlated negatively with dog-owner interaction. Since *Stranger-directed Sociability* in this

study is characterised by items which are the opposite of excitability, there is a reliable agreement between our results and those highlighted by Kobelt et al. (2003).

In our study the level of *activity* decreased with age. In former studies, the decline of activity with age was found using questionnaires (Bain et al., 2001; Vas et al., 2007) and behavioural observations (Head et al., 1997; Siwak et al., 2001). In addition, Kubinyi et al. (2009) found that less than 2.5-year-old dogs were the least calm and the calmest dogs were over 6.9 years of age. Ley et al. (2009) also examined the changes in activity level in dogs belonging to different age groups and came to the same conclusion.

Housing condition was found to affect *activity* level, that is, dogs living in flats were reported to be the most active, while those living in a yard scored lowest on this factor. Although, to our knowledge, no study unveiled the effect of housing condition on the activity level of dogs, it is common assumption that smaller dogs, kept more typically in flats, may appear to be more active.

We found that dogs taking part in organised training were characterised more aggressive than untrained ones. In line with our result Roll and Unshelm (1997) concluded, that the dog's training background as well as the owner's attitude towards obedience training has, among other factors, a notable impact on the dog's aggressive behaviour. Besides that, owners lacking strong attachment to the dog may attribute more aggression to their pet. Owners believing that organised training is essential to avoid losing control over the dog had more aggressive dogs than those who thought that training should either be fun or is not relevant at all. We must note, however, that in spite of the fact that our findings are in harmony with that of Roll and Unshelm (1997), we feel that one must be careful with interpreting the results solely from this angle because this does not necessarily reflect a causal relationship. It is also possible that dogs which behave aggressively are taken to dog training schools in order to get their behaviour corrected or changed. Furthermore, robust dogs kept for the purpose of guarding are represented in great numbers in dog training schools while small ones are not typically taken there. Moreover, aggressive acts like an attempt to bite a human are usually not taken seriously in the case of small dogs (Duffy et al., 2008). For these reasons, in further research, a question like "Why have you taken your dog to a dog training school?" should be included in questionnaires.

Podberscek and Serpell (1997) as well as Hsu and Sun (2010) found that those dogs that spent a lot of time with their owners were rated less aggressive compared to those who spent little time with them. Although we did not include a question like "To what extent are you attached to your dog?", to our view, the question "To what extent do you think your dog understands human speech?" may provide some reflection on the nature of the relationship between owner and pet. Dogs considered to understand words only were rated more aggressive than the ones which were believed to understand sentences. Owners considering that their dog understands quite well what people are talking about rated their dog the least aggressive. However, the latter case could also be explained by the attitude of these people towards their pet, that is, the

stronger anthropomorphic attitude they reflect, the less aggressive they perceive their dog's behaviour.

Not surprisingly, dogs having taken part in organised training got higher scores for *Trainability* than their non-trained conspecifics. Furthermore, the greater extent the dog was reported to be able to understand human speech the higher it was scored on the factor *Trainability*. In line with our results Kubinyi et al. (2009) found that previous training experience with dogs as well as frequent playing with the owner correlated with higher trainability. These factors should be taken into account when dog-breeds are compared in relation to trainability by means of questionnaires. Besides that it is also possible that more anthropomorphic humans perceive their pet differently from those who lack this kind of attitude. For these reasons we believe that further studies should pay attention to the underlying factors having a potential impact on humans' perceptions concerning their pet.

#### 4.3. Breed group differences

Very few studies have explored the differences in the behavioural tendencies which may be observed in different breed groups (e.g. Jones and Gosling, 2005; Svartberg, 2006; Ley et al., 2009) and which are considered to be remnants from past selection determined by the original purpose of breeding (e.g. Hart and Miller, 1985; Scott and Fuller, 1965). The FCI classification we applied is based partly on similarities among breeds regarding their original function.

The fact that the Terriers were found to score highest on *Stranger-directed Sociability* of all the breed groups may come as a surprise. The reason for this may root in the way the owners in this study perceived these dogs. Two third of them declared that their dog understands fluent human speech or whole sentences while only one third claimed that their dog can grasp words or intonations only. Terriers are becoming more and more popular as family dogs, and this tendency in Hungary may account for the results obtained. Since in our sample only 29 dogs represented the Terrier breed group, a bigger sample size may have provided a more balanced picture.

There were also significant differences between Terriers, Mongrels and Sheep- and Cattle Dogs in *Activity*. Sheep- and Cattle Dogs were found to be the most active while Terriers scored somewhat lower than Sheep- and Cattle Dogs and Sighthounds got the lowest scores. In the case of *Trainability* Retrievers – Flushing Dogs – Water Dogs were scored lower than Mongrels. This result may not be in harmony with the general view that Golden and Labrador Retrievers are among the most trainable breeds (e.g. Serpell and Hsu, 2005). If we consider, however, that spaniels are also part of this breed-group and, for example, the English Cocker Spaniel (which comprise nearly one-third of our sample) is prone to show problem behaviours (e.g. Amat et al., 2010) our result may not come as a surprise. In parallel, more and more attention (and increased empathy) is being paid to mixed-breed dogs. Until the early 1980s mongrels were typically excluded from obedience competitions. By now, a number of opportunities have opened up for them and they have proved to excel even at dog sports like agility, flyball

and frisbee. Moreover, 77% of Labrador and Golden Retrievers in the present sample were not trained at all which, as has been discussed above, may have affected the way the owners scored their pet.

As far as *Aggressiveness* is concerned, no significant variation could be observed between any of the breed-groups.

Considering that with the addition of a separate mixed-breed category eleven groups were compared, the number of the statistically different groups is low. The lack of the detectable differences, however, is in harmony with the findings of Svartberg (2006). He also found that there was little correspondence between the breed groups and their historical origin and function (Svartberg, 2006). The reason for this phenomenon may root in the overwhelming cultural changes modern Western countries went through in the past few decades. During this period dogs' practical functions have started to diminish because in most households dogs have been kept as companion animals. The changes in recent selection may have altered breed-specific behaviour as well (Svartberg, 2006).

The other possible explanation for the similar outcomes of the two investigations, however, is that the effect of the demographic variables in both samples overshadowed the otherwise existing differences. Moreover, the owners who provided information in the investigations on voluntary basis must have been interested in issues regarding dogs. For this reason, the samples in the two studies might not represent the general dog population. Whatever factors lie behind the results of the two studies, the correspondence between them is undeniable and should serve as a basis for triggering further investigations.

#### 4.4. Differences between two breeds

In the first comparative analysis the Hungarian Vizslas and the German Shepherd Dogs showed that in the case of *Stranger-directed Sociability* and *Activity* the mean scores for both breeds were around the population means, but in the case of *Aggressiveness* the Hungarian Vizsla obtained significantly lower scores than the German Shepherd Dog. The same applied to *Trainability*.

However, further analysis of the matched samples showed that this difference was the result of the alterations in environmental factors. The underlying factor found to cause the difference in the first sample of the German Shepherd Dog was housing condition, influencing both *Aggressiveness* and *Trainability*. Dogs living in a flat were found to be the least trainable, the ones living in the garden slightly more trainable while the ones which spent most of their lives both in the house and in the garden the most trainable. Similarly, dogs living in flats were scored the least aggressive and the ones living in a garden were assessed the most aggressive. These findings are in harmony with previous results, that is, the more time a dog spent together with the owner the less aggressive it was reported to be (Hsu and Sun, 2010). However, the result must be interpreted with caution. It is quite evident that dogs spending most of their lives in a flat have the greatest amount of daily interaction with their owner and this might be the reason why they are rated the lowest on *Aggressiveness*, while those which spent most of their time in the garden guarding the

house and reacting to the passing people with barking the most aggressive. The other possible explanation is that the group of dogs living in flats may serve as companion animals, as a result, their owner do not find them aggressive. In parallel, there may be fewer stimuli in a flat which could provoke signs of aggression like barking and threatening behaviour towards strangers walking in the street. Further research is necessary to find out how housing condition affects dogs' aggression and/or the owners' perception of their dog's aggression.

German Shepherd Dogs living in flats may not be able to do as much physical exercise as they need, which may bring about some restless behaviour and other unwanted actions. In the present research *Trainability* is characterised by learning things easily, pleasing the owner, being controllable and not disorganised. It is common assumption that dogs which are confined in a relatively small place perform extra activities, such as tearing different things apart like slippers, etc., in consequence, are not considered controllable and organised, thus do not make the impression that they learn things easily, that is, follow the instructions of the owners. For this reason, owners may not feel that their pet does what they want them to do and rate low on the variable 'pleases the owner'. In addition, owners living in flats may have bought their dog to have a companion animal and even if they try to teach their pet some exercises to perform, they might not know how to handle a dog in the proper way. Probably these are the reasons why these dogs score low on this factor. Further research is necessary to unveil the correlation, if there is any, between the owner's competence in handling dogs and the ratings given to their dog on the variables constituting the factor *Trainability*.

Dogs living in the garden only may be kept solely for the purpose of guarding the house, which task does not require special training background. The fact that they are not allowed into the house may reflect the lack of strong emotional bonds between human and pet. This may be a reason why, they are not rated high on the items constituting *Trainability*. In contrast, the fact that some owners let their relatively big dog go into the house suggests a strong emotional bond between those owners and their pet. Being allowed into the house also implies non-destructive, controllable behaviour which may explain the high scores on the variables 'learning things easily', 'pleasing the owner', 'being controllable' and 'not disorganised'.

These results also warn against the uncritical use of breed comparisons based on experts' opinion. Breed differences, even if they show cross-nation similarities may reflect a combination of genetic and environmental factors rather than breed-specific (genetic) effects per se (see also Bradshaw et al., 1996; Notari and Goodwin, 2007).

## 5. Conclusions

There have been few investigations aiming to reveal differences in the personality dimensions of individual dogs belonging to pure breeds and/or breed groups. In this study we implemented a novel type of questionnaire that relies on simple adjectives to characterise the behaviour of individual dogs. The scales obtained show good correspondence with those published by others (e.g.

Gosling et al., 2003; Hsu and Serpell, 2003; Kubinyi et al., 2009; Svartberg and Forkman, 2002; Ley et al., 2008; Jones and Gosling, 2005).

The comparison of breed-groups and breeds revealed little differences which also parallel earlier findings. Our observations suggest that these environmental factors could mask or even enhance breed differences. Breed groups may contain dog breeds which are actually kept in very different ways. If breeds with such different environmental history are combined in one breed group, it is less surprising that the relatively large variation masks any potential breed-group specific effects. Dogs living with the owners in flats may also be more similar irrespectively of the breed because owners try to choose those individuals within a breed which can conform to such living conditions. For example, owners may perceive German Shepherd Dogs living in the garden or in the flat in a different way. For this reason, further research should pay attention to balancing the demographic variables in the samples, otherwise, the environmental factors will in all probability put shadow on the genetically determined differences or similarities they intend to unveil between the target breeds and/or breed groups.

## Acknowledgements

The research described here was supported by the European Union (LIREC-215554), the Hungarian Scientific Research Fund (OTKA T049692, K84036), and the Bolyai Foundation of the Hungarian Academy of Sciences. The authors are grateful to all the owners who participated in this research for their support throughout the study.

## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.applanim.2012.02.016.

## References

- Amat, M., Manteca, X., Mariotti, V.M., Ruiz de la Torre, J.L., Fatjó, J., 2010. Aggressive behavior in the English cocker spaniel. *J. Vet. Behav.* 4, 111–117.
- Armor, D.J., 1974. Theta reliability and factor scaling. In: Costner, H.L. (Ed.), *Sociological Methodology*. Jossey-Bass, San Francisco, pp. 17–50.
- Bain, M.J., Hart, B.L., Cliff, K.D., Ruehl, W.W., 2001. Predicting behavioral changes associated with age-related cognitive impairment in dogs. *J. Am. Vet. Med. Assoc.* 218, 1792–1795.
- Bradshaw, J.W.S., Goodwin, D., Lea, A.M., Whitehead, S.L., 1996. Behavioural characteristics of pure-bred dogs in the United Kingdom. *Vet. Rec.* 138, 465–468.
- Costa Jr., P.T., McCrae, R.R., 1992. NEO-PI-R: Professional Manual. Psychological Assessment Resources, Odessa, FL.
- Digman, J.M., 1990. Personality structure: the emergence of the five factor model. *Annu. Rev. Psychol.* 41, 417–440.
- Duffy, D.L., Hsu, Y., Serpell, J.A., 2008. Breed differences in canine aggression. *Appl. Anim. Behav. Sci.* 114, 441–460.
- Goddard, M.E., Beilharz, R.G., 1984. The relationship of fearfulness to, and the effects of sex, age and experience on exploration and activity in dogs. *Appl. Anim. Behav. Sci.* 12, 267–278.
- Goldberg, L.R., 1993. The structure of phenotypic personality traits. *Am. Psychol.* 48, 26–34.
- Golini, L., Colangeli, R., Tranquillo, V., Mariscoli, M., 2009. Association between neurologic and cognitive dysfunction signs in a sample of aging dogs. *J. Vet. Behav.* 4, 25–30.

- Gosling, S.D., 1998. Personality dimensions in spotted hyenas (*Crocuta crocuta*). *J. Comp. Psychol.* 112, 107–118.
- Gosling, S.D., John, O.P., 1999. Personality dimensions in non-human animals: a cross species review. *Curr. Dir. Psychol. Sci.* 8, 69–75.
- Gosling, S.D., Kwan, V.S.Y., John, O.P., 2003. A dog's got personality: a cross-species comparative approach to evaluating personality judgments. *J. Pers. Soc. Psychol.* 85, 1161–1169.
- Gottlieb, G., 2002. *The Complete Hungarian Vizsla*. Ringpress.
- Head, E., Callahan, H., Cummings, B.J., Cotman, C.W., Ruehl, W.W., Muggenberg, B.A., Milgram, N.W., 1997. Open-field activity and human interaction as a function of age and breed in dogs. *Physiol. Behav.* 62, 963–971.
- Hart, B.L., Miller, M.F., 1985. Behavioral profile of dog breeds. *J. Am. Vet. Med. Assoc.* 186, 1175–1180.
- Hsu, Y., Serpell, J.A., 2003. Development and validation of a questionnaire for measuring behavior and temperament traits in pet dogs. *J. Am. Vet. Med. Assoc.* 223, 1293–1300.
- Hsu, Y., Sun, L., 2010. Factors associated with aggressive responses in pet dogs. *Appl. Anim. Behav. Sci.* 123, 108–123.
- Jones, A.C., Gosling, S.D., 2005. Temperament and personality in dogs (*Canis familiaris*): a review and evaluation of past research. *Appl. Anim. Behav. Sci.* 95, 1–53.
- Kobelt, A.J., Hemsworth, P.H., Bamett, J.L., Colman, G.J., 2003. A survey of dog ownership in suburban Australia—conditions and behaviour problems. *Appl. Anim. Behav. Sci.* 82, 137–148.
- Kubinyi, E., Turcsán, B., Miklósi, Á., 2009. Dog and owner demographic characteristics and dog personality trait associations. *Behav. Proc.* 81, 392–401.
- Ley, J., Bennett, P., Coleman, G., 2008. Personality dimensions that emerge in companion canines. *Appl. Anim. Behav. Sci.* 110, 305–317.
- Ley, J.M., Bennett, P.C., Coleman, G.J., 2009. A refinement and validation of the Monash Canine Personality Questionnaire (MCPQ). *Appl. Anim. Behav. Sci.* 116, 220–227.
- Martin, P., Bateson, P., 2007. *Measuring Behaviour*, 3rd edition. Cambridge University Press, Cambridge, UK.
- Miklósi, Á., 2007. *Dog Behaviour, Evolution, and Cognition*. Oxford University Press, New York.
- Murphy, J.A., 1995. Assessment of temperament of potential guide dogs. *Anthrozoös* 13, 224–228.
- Murphy, J., 1998. Describing categories of temperament in potential guide dogs for the blind. *Appl. Anim. Behav. Sci.* 58, 163–178.
- McCrae, R.R., John, O.P., 1992. An introduction to the five-factor model and its applications. *J. Pers.* 60, 175–215.
- McGreevy, P.D., Nicholas, F.W., 1999. Some practical solutions to welfare problems in dog breeding. *Anim. Welf.* 8, 329–341.
- Netto, W.J., Planta, D.J.U., 1997. Behavioural testing for aggression in the domestic dog. *Appl. Anim. Behav. Sci.* 52, 243–263.
- Notari, L., Goodwin, D., 2007. A survey of behavioural characteristics of pure-bred dog sin Italy. *Appl. Anim. Behav. Sci.* 103, 118–130.
- Podberscek, A.L., Serpell, J.A., 1997. Environmental influences on the expression of aggressive behaviour in English Cocker Spaniels. *Appl. Anim. Behav. Sci.* 52, 215–227.
- Roll, A., Unshelm, J., 1997. Aggressive conflicts amongst dogs and factors affecting them. *Appl. Anim. Behav. Sci.* 52, 229–242.
- Scott, J.P., Fuller, J.L., 1965. *Genetics and the Social Behaviour of the Dog*. University of Chicago Press, Chicago.
- Serpell, J., Hsu, Y., 2005. Effects of breed, sex, and neuter status on trainability in dogs. *Anthrozoös* 18, 196–207.
- Sheppard, G., Mills, D.S., 2002. The development of a psychometric scale for the evaluation of the emotional predispositions of pet dogs. *Int. J. Comp. Psychol.* 15, 201–222.
- Siwak, C.T., Murphey, H.L., Muggenberg, B.A., Milgram, N.W., 2001. Age-dependent decline in locomotor activity in dogs is environment specific. *Physiol. Behav.* 75, 65–70.
- Svartberg, K., Forkman, B., 2002. Personality traits in the domestic dog (*Canis familiaris*). *Appl. Anim. Behav. Sci.* 79, 133–155.
- Svartberg, K., 2002. Shyness–boldness predicts performance in working dogs. *Appl. Anim. Behav. Sci.* 79, 157–174.
- Svartberg, K., 2005. A comparison of behaviour in test and in everyday life: evidence of three consistent boldness-related personality traits in dogs. *Appl. Anim. Behav. Sci.* 91, 103–128.
- Svartberg, K., 2006. Breed-typical behaviour in dogs – historical remnants or recent constructs? *Appl. Anim. Behav. Sci.* 96, 293–313.
- Tabachnick, B.G., Fidell, L.S., 2001. *Using Multivariate Statistics*, fourth edition. Allyn & Bacon, Needham Heights, MA.
- Tupes, E.C., Cristal, R.E., 1992. Recurrent personality factors based on trait ratings. *J. Pers.* 60, 225–251.
- Vas, J., Topál, J., Péch, É., Miklósi, Á., 2007. Measuring attention deficit and activity in dogs: a new application and validation of a human ADHD questionnaire. *Appl. Anim. Behav. Sci.* 103, 105–117.
- Vazire, S., Gosling, S.D., Dickey, A.S., Schapiro, S.J., 2007. Measuring personality in nonhuman animals. In: Robins, R.W., Fraley, R.C., Krueger, R.F. (Eds.), *Handbook of Research Methods in Personality Psychology*. Guilford, New York, pp. 190–206.
- Wemelsfelder, F., Hunter, E.A., Mendl, M.T., Lawrence, A.B., 2000. The spontaneous qualitative assessment of behavioural expressions in pigs. First explorations of a novel methodology for integrative animal welfare. *Appl. Anim. Behav. Sci.* 67, 193–215.