

# 1 **The effect of the owner's personality on the behaviour of owner-dog**

## 2 **dyads**

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## 7 **Summary**

8 We describe the relationships between dog owners' personality attributes (assessed via  
9 questionnaire), their behaviors and the dog's behaviors observed during brief dog-owner  
10 and dog-stranger interactions (N = 78). Interactions comprised the owner commanding  
11 the dog to sit, and the stranger showing a ball to the restrained dog and then hiding it.  
12 Owners scoring higher on neuroticism and openness used more commands (gestural and  
13 verbal) when asking the dog to sit, and the dogs of owners higher on neuroticism spent  
14 more time looking at the stranger. More extraverted owners praised their dog more, and  
15 it took longer for their dogs to look at the stranger but they spent more time looking at  
16 the stranger, whereas dogs of more agreeable owners spent more time looking at the  
17 ball. Based on these results we conclude that some aspects of owners' personality  
18 appear to be tied to their dog's attentional concerns.

## 19 **Introduction**

### 20 *Dog-human relationship*

21 Humans engage in heterospecific interactions with a variety of agents ranging from  
22 different animal species (e.g. Podberscek, Paul, & Serpell, 2000; Robinson, 1995) to

1 social robots (Thrun, 2004). Among these interactions the perhaps most widely studied  
2 one is the human-dog interaction.

3 Dogs are among the most popular pets in the western world (Hart, 1995) and are  
4 present in almost every human society worldwide (Serpell, 2003). They have evolved  
5 specialized skills for reading human social and communicative behaviour, which  
6 enabled them to perform tasks to assist humans (e.g. the comprehension of human  
7 pointing gestures is a basic skill in assistance dogs or following human gaze is useful in  
8 everyday cooperative situations) (Cooper, 2003; Hare & Tomasello, 2005; Miklósi,  
9 Topál, & Csányi, 2004). Dogs show attachment to their owner (Topál, Miklósi, Csányi,  
10 & Dóka, 1998; Prato-Previde, Custance, Spiezio, & Sabatini, 2003) that by definition  
11 means a special affectional relationship based on dependency between individuals that  
12 becomes evident through behavioural preferences (Wickler, 1976).

### 13 *Dog-human interaction and the role of personality*

14 Variation exists in the relationship between owners and their dogs and in the function  
15 of such relationships (Hart, 1995). There are highly coordinated owner-dog units, such  
16 as blind owners and their guide dogs (Naderi, Miklósi, Dóka, & Csányi, 2001), while  
17 there are dogs that would not even reliably return when called (Serpell, 1996). The  
18 personality of the owner might affect the type of relationship he or she prefers to foster  
19 with a companion animal. Previous studies reported associations between the owners'  
20 and dogs' personality, for instance, Podberscek & Serpell (1997) showed that owners of  
21 highly aggressive English cocker -spaniels were emotionally less stable, shy,  
22 undisciplined and more likely to be tense than owners of low aggressive spaniels. More  
23 recent studies also found some degree of similarity between the owners' and dogs'  
24 personality profile (Turcsán, Kubinyi, Virányi, & Range, 2011).

1 A number of studies have already investigated the interaction of human-dog dyads in  
2 situations like interspecific play (Mitchell & Thompson, 1986, 1990, 1991; Rooney,  
3 Bradshaw, & Robinson, 2001) and problem solving tasks (e.g. Topál, Miklósi, &  
4 Csányi, 1997). There are also some studies that used “field-based” methodology  
5 focusing on the aspects related to dog-training (e.g. Braem & Mills, 2010; Fukuzawa,  
6 Mills, & Cooper, 2005). They found that varying the way an experimental trainer  
7 communicates (e.g. posture, eye-contact) with the dog when giving simple commands  
8 like “come” and “sit” influences the obedience of the dogs.

9 However, despite the extended literature on dog-human relationship, little is known  
10 about the effects of the owners’ personality on the dog-owner dyadic interactions.  
11 Recently it has been reported (Kotrschal, Schöberl, Bauer, Thibaut, & Wedl, 2009)  
12 how the personality of owners relates to the owners’ attachment toward their dogs and  
13 how this attachment affects the performance of human-dog dyads in tasks involving  
14 different kinds of dog-human interactions like saliva sampling or teaching new tricks.  
15 This study revealed that the higher the owners scored in neuroticism, the more they  
16 considered their dog a social supporter which was related to a low dyadic functionality  
17 (e.g. they engaged less in shared activities with the dog). In contrast, the higher owners  
18 scored in extraversion, the less they tended to consider their dogs as social supporters  
19 and the more these owners appreciated shared activities with their dogs. However, the  
20 authors noted that due to the low sample size (N=22) the results need to be interpreted  
21 cautiously. Data on the same subjects was later published with a slightly different focus  
22 (Wedl, Schöberl, Bauer, Day, & Kotrschal, 2010) concluding that the personality of the  
23 owners and dogs, the nature of the human-dog attachment, and the owner-dog  
24 relationship (e.g. shared activity) may influence dogs’ social attraction to their owners.

1 *Aims of the study*

2 In the present paper we aim to give a detailed behavioural analysis of the human-dog  
3 interaction in a short series of simple actions observing a large number of human-dog  
4 dyads. Behavioural observations were complemented by the measurement of human  
5 personality and some general information (including dog keeping practices). Our  
6 objective was to examine consistent relationships in the behaviors of dogs and their  
7 owners or a stranger in interaction with each other, and to discern the influences of  
8 owner personality on dog behavior by means of multivariate statistical methods.

9 **Material and methods**

10 *Subjects*

11 A total of 78 dog-owner pairs participated in the experiment. Owners from a database  
12 containing approximately six hundred volunteers were contacted in alphabetical order  
13 and they took part in the study if their dog could be described as “motivated to play with  
14 a ball” and they themselves were willing to participate in the experiment. The test was  
15 conducted in the Clever Dog Lab, Vienna from July to September 2009. Owners were  
16 14 males and 64 females, all older than 18 years old with an average age of 43.8 ( $\pm 19.0$ )  
17 years. Dogs were 40 males and 38 females from 27 different breeds and 15 mongrels.  
18 They were all older than one year with an average age of 4.2 ( $\pm 2.6$ ) years. Some of the  
19 owner-dog pairs had previously participated in other behaviour tests but all of them  
20 were naive to the current experiment. All tests were carried out by the same 22 years old  
21 female, who was unfamiliar to all subjects.

22 *Procedure*

1 . To assess the human personality we used the German version of the Big Five  
2 Inventory (BFI, John & Srivastava, 1999) translated and validated by Lang, Lüdtke &  
3 Asendorpf (2001), measuring neuroticism, extraversion, openness, agreeableness and  
4 conscientiousness. Neuroticism refers to the tendency to be anxious, insecure, and self-  
5 pitying versus calm, secure, and self-satisfied . Extraversion refers to the tendency to be  
6 sociable, fun-loving, and affectionate versus retiring, somber, and reserved. Openness  
7 refers to the tendency to be imaginative, independent, and interested in variety versus  
8 practical, conforming, and interested in routine. Agreeableness refers to the tendency to  
9 be softhearted, trusting, and helpful versus ruthless, suspicious, and uncooperative.  
10 Conscientiousness refers to the tendency to be organized, careful, and disciplined versus  
11 disorganized, careless, and impulsive. The questionnaire consisted of 44 items (e.g. “*I*  
12 *see myself as someone who is sometimes shy, inhibited*”) and the owners had to rate  
13 themselves on each item using a five-point scale (disagree strongly - agree strongly).

14 After the owners completed the questionnaire the dog and the owner entered the test  
15 room (6.3 m x 4.8 m) together with the female experimenter (E). The test consisted of  
16 two phases where we observed human-dog interaction with the owner and the  
17 experimenter, respectively. We applied two short scenarios that also resembled to  
18 everyday life events. First the dog had to accomplish a simple and already known  
19 command that was given by the owner in a somewhat novel context. Then a stranger  
20 manipulated a ball calling the dog’s attention to her actions in a social learning-like  
21 communicative context.

22 In the first test phase (approximately 30 s) the owner was instructed to make the dog  
23 sit in the middle of the room as he/she usually does and to walk around the room while  
24 the dog was expected to stay at the same place. After walking around, the owner

1 returned to the dog and was instructed to hold the dog's collar (video:  
2 <http://www.cmdbase.org/web/guest/play/-/videoplayer/23>). Then in the second phase,  
3 (approximately 15 s) the E placed an opaque screen (30 cm wide x 50 cm high x 30 cm  
4 deep) and a tennis ball 2 m from the dog and 1 m from each other. First E called the dog  
5 to get its attention while standing next to the dog-owner pair, then she walked to the ball  
6 without looking at the dog. E picked the ball up, and said "Schau mal!" (the German  
7 equivalent of "Look!") to the dog. Next she walked to the screen and hid the ball behind  
8 it, then walked back to the subject showing her empty hands (video:  
9 <http://www.cmdbase.org/web/guest/play/-/videoplayer/24>).

10 Both phases were videotaped with a four-camera-system for later analysis.

#### 11 *Data analysis*

12 Five behaviour variables were analysed to describe the dogs' reactions during the  
13 interactions. In *Phase 1* we measured the *Latency of accomplishing the command* from  
14 the moment when the dog-owner pair entered the room and the *Time spend looking at*  
15 *owner* from the moment when the dog took the sitting position. In *Phase 2* the *Latency*  
16 *to look at the experimenter*, *Time spend looking at the experimenter* and *Time spend*  
17 *looking at the ball* was measured from the moment when the experimenter called the  
18 dog. We also recorded the number and type of the commands the owners used in Phase  
19 1 (Table 1). A *Verb* was defined as an utterance containing a single verb (e.g. "Sitz!"  
20 "Bleib!", that is "sit" "stay"); an *Attention getter* contained the dogs' name and/or the  
21 utterance "Schau mal!" ("look"); a *Praise* was a positive utterance such as "Super!" or  
22 "Gut gemacht!". We also calculated the *Total verbal information* that was the sum of  
23 *Verbs*, *Attention getters* and *Praises*. A *Hand sign* was defined as a voluntary hand  
24 movement directed towards the dog.

1 Behavioural variables were coded with frame-by-frame inspection of the recordings  
2 using Solomon Coder (© András Péter, <http://solomoncoder.com/>), a widely used  
3 behaviour coding software (e.g. Horn, Virányi, Miklósi, Huber, & Range, 2011;  
4 Marshall-Pescini, Passalacqua, Barnard, Paola Valsecchi, & Prato-Previde, 2009).  
5 Reliability measures (Cohen's Kappa) for both phases were obtained by double coding  
6 of 20 videos. According to the categorization by Landis & Koch (1977) almost perfect  
7 agreement (0.81-1) was found for all variables. The personality questionnaire was  
8 evaluated only after the behaviour test.

9 Based on these data we gave a multivariate description of the dyads' interaction using  
10 Redundancy Analysis (RDA, Wollenberg, 1977). Behaviour variables from both the  
11 owner and the dog were entered to the same statistical model and the owner's  
12 personality factors were used as explanatory variables. This method is suitable to  
13 qualitatively analyze data sets where the explanatory variables (in this case the owners'  
14 personality) are supposed to influence the other variables (in this case the behavioural  
15 variables coded in the two test phases) without the latter having an influence on them.  
16 Although human personality might depend on several factors, based on a definition by  
17 Funder et al (1997) suggesting that personality is stable across time and situations, for  
18 this analysis we supposed that the owners' personality was uninfluenced by the dogs'  
19 behaviour. We further assumed that the owners might impact the behaviour of their  
20 dog by actively choosing the breed or individual they want to live with.

21 For statistical analysis we used Syntax 2000 (© János Podani,  
22 <http://ramet.elte.hu/~podani/subindex.html>), a widely used multivariate statistical  
23 analysis software (e.g. Altobelli, Bressan, Feoli, Ganis, & Martini, 2006; Bourgeois,  
24 Kenkel, & Morrison, 1997).

1

## 2 **Results**

3 In order to give a general picture of what happened in the two phases of the test, first  
4 we provide descriptive results (average and SD). During the first test phase the owners  
5 used 2.5 ( $\pm 1.9$ ) hand signs and 9.7 ( $\pm 7.6$ ) pieces of verbal information out of which 6.6  
6 ( $\pm 4.8$ ) were verbs, 1.9 ( $\pm 2.0$ ) were attention getters and 0.7 ( $\pm 1.2$ ) were praise. The dogs  
7 needed 18.7 ( $\pm 14.7$ ) seconds to accomplish the “Sit!” command, and they were looking  
8 at the owner 86.4 ( $\pm 13.5$ ) % of the time. In the second phase, the dogs looked at the  
9 experimenter with a mean latency of 0.55 ( $\pm 0.70$ ) second when she called their  
10 attention. The dogs were looking at the experimenter 66.2 ( $\pm 28.3$ ) % of the time, and at  
11 the ball 28.1 ( $\pm 27.6$ ) % of the time.

12 An RDA was carried out on data gathered from the interaction test with the owner’s  
13 personality factors as explanatory variables. Owner-dog pairs were therefore positioned  
14 in an N dimensional space (with N being the number of axes) according to both the  
15 owners’ and the dogs’ behaviour. The axes were similarly derived as those of a  
16 Principal Component Analysis (PCA), that is data reduction method was used to  
17 decrease the number of axes/dimensions by reducing the number of variables through  
18 computing behavioural factors containing more than one variable. The analysis results  
19 in a treeplot (Figure 1) where the first two dimensions/axes (the ones with most  
20 explained variance) are plotted with the two axes representing behavioural factors  
21 expressed in arbitrary units. The two canonical RDA axes explained 70% of the total  
22 variance (for comparison see ecological studies using the same method: e.g. 38.8% in  
23 Tinya, Márialigeti, Király, Németh, & Ódor, 2009). In order to make visible the  
24 behavioural variables which constitute the factors, the variables are also plotted (black



1 circles) and labeled on the figure. A bigger distance from zero means a bigger load on  
2 the factor. Each dog-owner pair is plotted according to their values for the two  
3 behavioural factors (axis 1 and 2).

4 Explanatory variables (personality factors of the owner) are plotted according to their  
5 relatedness to axes 1 and 2 (gray triangles). The visual examination of the treeplot  
6 (Figure 2) showed that the first axis (explained variance 42%) was associated positively  
7 with the owners' scores on extraversion and negatively with the scores on  
8 agreeableness. The second axis (explained variance 28%) was associated positively with  
9 the owners' scores on openness and negatively with the scores on conscientiousness.  
10 Owners' neuroticism was associated positively with both axes to some extent.

11 The treeplot of the RDA provides information also on the relationship between the  
12 owners' personality traits and the behaviour of the dyads; the physical distance between  
13 the lines connecting the personality factors (plotted as gray triangles) to the origo and  
14 the behavioural variables (plotted as black dots) means relatedness. Owners'  
15 neuroticism was associated with the dogs' accomplishing the "Sit!" command with a  
16 higher latency and looking more to the experimenter in the second phase. Furthermore,  
17 neuroticism and openness traits were positively related to the number of hand signs and  
18 commands the owners used in the first test phase (total number of commands, attention  
19 getters, and verbs). The owners' extraversion trait was also related to the number of  
20 praise the owners used in this phase. Moreover, owners who rated themselves higher on  
21 extraversion had dogs which looked with a higher latency at the experimenter and spent  
22 more time looking at her in the second test phase. Dogs with highly agreeable owners  
23 spent more time looking at the ball in the second test phase.

## 24 **Discussion**

1 *Analysing dog-human interaction*

2 In the present paper we described the social interaction of dog-human dyads while  
3 accomplishing simple tasks and revealed that the owners' personality relates to the  
4 observed behaviour in dogs. The main advantage of the present study is that the use of a  
5 multivariate method allowed us to describe the interaction of a large number of owner-  
6 dog dyads by the means of a single statistical model. These descriptive statistics are  
7 widely used in ecological studies (e.g. Guisan, 2000) where a lot of field data are  
8 available in order to give a unified description of the whole study area. However,  
9 behaviour observations carried out with relatively low sample sizes are usually analyzed  
10 with univariate methods (although see Everitt, 2009 for multivariate analysis of  
11 behavioural data) focusing on only one variable in each statistical test.

12 It has already been proposed that owner-dog dyads might function as one unit  
13 (Mitchell & Thompson, 1991; Naderi et al., 2001), for example due to a common goal.  
14 We suggest that there is a variation to what extent owner-dog dyads form a unit. In the  
15 present study we showed that dyadic behaviour can be studied not only in complex  
16 situations (such as playing or mastering an obstacle course) but also in a very simple  
17 situation.

18 *The effect of the owners' personality on dog-human interaction*

19 It was reported earlier (Kotrschal et al., 2009) that the higher the owner's score in  
20 neuroticism, the greater their attachment was to their dogs. In parallel we revealed that  
21 owners scoring higher in neuroticism use more commands and hand signs when making  
22 the dog to perform a simple obedience task (sit and stay) which might be a sign of social  
23 relatedness. The close social relationship of owners with their dogs associated with  
24 neuroticism was also reported to be linked to low dyadic functionality by Kotrschal et

1 al. (2009). Similarly we found that higher scores on neuroticism in owners were also  
2 related to higher latencies when accomplishing the “Sit!” command in dogs. Braem &  
3 Mills (2010) found also that with the handler giving additional verbal information  
4 besides the command (that is comparable with the total verbal information in our test)  
5 the dog’s obedience decreased (comparable to latency of accomplishing the command  
6 in the present experiment).

7 Owners scoring high in extraversion seem to have more extraverted dogs according to  
8 a recent questionnaire survey (Turcsán, Kubinyi, Virányi, et al., 2011). Similarly, we  
9 found that the owners’ extraversion was positively associated with the dogs’ looking at  
10 the owner in the first test phase and their looking at the experimenter in the second  
11 phase, while less social behaviours like looking at the ball were negatively related to  
12 this personality trait. However, we also found previously unreported connections of the  
13 owners’ openness and agreeableness to the dog and owner behaviour: the owners’?  
14 openness trait was positively related to the number of hand signs and commands they  
15 used in the first test phase (total number of commands, attention getters, and verbs)  
16 while dogs with highly agreeable owners spent more time looking at the ball in the  
17 second test phase.

#### 18 *Dog-owner interaction in a broader sense*

19 Our results showed a continuous distribution of the human-dog dyads along the RDA  
20 dimensions. It seems that at least in the pet dog population available for testing, the  
21 dyads do not form separate groups on the basis of their behaviour. This finding is  
22 seemingly in contradiction with previous results about dog breed groups being clearly  
23 separated based on behavioural traits like trainability (Turcsán, Kubinyi, & Miklósi,  
24 2011), aggressiveness (Duffy, Hsu, & Serpell, 2008) or nerve stability (Wilsson &

1 Sundgren, 1997); however an important novelty of the present experiment is that we  
2 considered the behaviour of both the owner and the dog. Similarly to the findings of  
3 previous research (Kotrschal et al., 2009; Turcsán, Kubinyi, Virányi, et al., 2011; Wedl  
4 et al., 2010) we found a relationship between the behaviour of owners and their dogs in  
5 many aspects.

6 Mitchell & Edmonson (1999) described how owners talk to their dogs in a play  
7 situation. They found that many of them “chatted” to their dogs in quite a complex way  
8 using repetitive talk. Similarly, we found that owners in this context used imperatives  
9 (verbs) and attention getters the most frequently during the interaction.

10 It is also important to point out that, as we have seen, the owners’ personality has an  
11 impact on how the dogs behave, which might also bias the results of such cognitive tests  
12 where the owners are allowed to participate actively (e.g. Elgier, Jakovcevic, Mustaca,  
13 & Bentosela, 2009; Prato-Previde, Marshall-Pescini, & Valsecchi, 2008).

#### 14 *Conclusion*

15 In sum, the present paper provided both a quantitative and a qualitative description of  
16 associations between the owners’ personality and the behaviour of a large number of  
17 owner-dog dyads during a simple interaction task. We found positive association  
18 between the owners’ and dogs’ general behaviour and revealed that the owners’  
19 personality influenced the dyad’s performance. Our exploratory study may stimulate  
20 further investigations of other everyday situations using the same multivariate model.

21

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## 6 **References**

- 7 Altobelli, A., Bressan, E., Feoli, E., Ganis, P., & Martini, F. (2006). Digital  
8 representation of spatial variation of multivariate landscape data. *Community*  
9 *Ecology*, 7(2), 181-188. doi:10.1556/ComEc.7.2006.2.5
- 10 Bourgeois, L., Kenkel, N. C., & Morrison, I. N. (1997). Characterization of cross-  
11 resistance patterns in aceryl-CoA carboxylase inhibitor resistant wild oat (*Avena*  
12 *fatua*). *Weed Science*, 45, 750-755.
- 13 Braem, M. D., & Mills, D. (2010). Factors affecting response of dogs to obedience  
14 instruction: A field and experimental study. *Applied Animal Behaviour Science*,  
15 125(1-2), 47-55. Elsevier B.V. doi:10.1016/j.applanim.2010.03.004
- 16 Cooper, J. (2003). Clever hounds: social cognition in the domestic dog (*Canis*  
17 *familiaris*). *Applied Animal Behaviour Science*, 81(3), 229-244.  
18 doi:10.1016/S0168-1591(02)00284-8
- 19 Duffy, D. L., Hsu, Y., & Serpell, J. A. (2008). Breed differences in canine aggression.  
20 *Applied Animal Behaviour Science*, 114, 441-460.  
21 doi:10.1016/j.applanim.2008.04.006
- 22 Elgier, A. M., Jakovcevic, A., Mustaca, A. E., & Bentosela, M. (2009). Learning and  
23 owner-stranger effects on interspecific communication in domestic dogs (*Canis*  
24 *familiaris*). *Behavioural Processes*, 81(1), 44-9. doi:10.1016/j.beproc.2008.12.023
- 25 Everitt, B. S. (2009). *Multivariable Modeling and Multivariate Analysis for the*  
26 *Behavioral Sciences* (pp. 1-304). CRC Press.
- 27 Fukuzawa, M., Mills, D., & Cooper, J. (2005). More than just a word: non-semantic  
28 command variables affect obedience in the domestic dog (*Canis familiaris*).  
29 *Applied Animal Behaviour Science*, 91(1-2), 129-141.  
30 doi:10.1016/j.applanim.2004.08.025
- 31 Funder, D., John, O. P., Robins, R., & Pervin, L. (1997). *Handbook of personality* (2nd  
32 ed.). New York: Guilford Press.

- 1 Guisan, a. (2000). Predictive habitat distribution models in ecology. *Ecological*  
2 *Modelling*, 135(2-3), 147-186. doi:10.1016/S0304-3800(00)00354-9
- 3 Hare, B., & Tomasello, M. (2005). Human-like social skills in dogs? *Trends in*  
4 *Cognitive Sciences*, 9(9), 439-44. doi:10.1016/j.tics.2005.07.003
- 5 Hart, L. A. (1995). Dogs as human companions: a review of the relationship. In J.A.  
6 Serpell (Ed.), *The Domestic Dog: Its Evolution, Behaviour and Interactions With*  
7 *People* (pp. 161–178). Cambridge: Cambridge University Press.
- 8 Horn, L., Virányi, Z., Miklósi, Á., Huber, L., & Range, F. (2012). Domestic dogs (*Canis*  
9 *familiaris*) flexibly adjust their human-directed behavior to the actions of their  
10 human partners in a problem situation. *Animal Cognition*, 15(1), 57-71.  
11 doi:10.1007/s10071-011-0432-3
- 12 John, O. P., & Srivastava, S. (1999). The Big-Five Trait Taxonomy: History,  
13 Measurement, and Theoretical Perspectives. *Handbook of Personality: Theory and*  
14 *Research*.
- 15 Kotrschal, K., Schöberl, I., Bauer, B., Thibeaut, A.-M., & Wedl, M. (2009). Dyadic  
16 relationships and operational performance of male and female owners and their  
17 male dogs. *Behavioural Processes*, 81(3), 383-91.  
18 doi:10.1016/j.beproc.2009.04.001
- 19 Landis, J. R., & Koch, G. G. (1977). The Measurement of Observer Agreement for  
20 Categorical Data. *Biometrics*, 33, 159-174.
- 21 Lang, F. R., Lüdtke, O., & Asendorpf, J. B. (2001). Validity and psychometric  
22 equivalence of the German version of the Big Five Inventory in young, middle-  
23 aged and old adults. *Diagnostica*, 47, 111-121.
- 24 Marshall-Pescini, S., Passalacqua, C., Barnard, S., Valsecchi, P., & Prato-Previde, E.  
25 (2009). Agility and search and rescue training differently affects pet dogs'  
26 behaviour in socio-cognitive tasks. *Behavioural Processes*, 81(3), 416-22.  
27 doi:10.1016/j.beproc.2009.03.015
- 28 Miklósi, Á., Topál, J., & Csányi, V. (2004). Comparative social cognition: what can  
29 dogs teach us? *Animal Behaviour*, 67(6), 995-1004.  
30 doi:10.1016/j.anbehav.2003.10.008
- 31 Mitchell, R. W., & Edmonson, E. (1999). Functions of Repetitive Talk to Dogs during  
32 Play: Control, Conversation, or Planning? *Society and Animals*, 7(1), 55–81.  
33 BRILL.
- 34 Mitchell, R. W., & Thompson, N. S. (1986). Deception in Play between Dogs and  
35 People. In R. W. Mitchell & N. S. Thompson (Eds.), *Deception. Perspectives on*  
36 *Human and Nonhuman Deceit* (pp. 193-205). State University of New York Press.

- 1 Mitchell, R. W., & Thompson, N. S. (1990). The effects of familiarity on dog-human  
2 play. *Anthrozoös*, 4(1), 24–43. Berg Publishers.
- 3 Mitchell, R. W., & Thompson, N. S. (1991). Projects, routines, and enticements in dog-  
4 human play. In P. P. G. Bateson & P. H. Klopfer (Eds.), *Perspectives in Ethology*  
5 *Vol. 9 Human Understanding and Animal Awareness* (pp. 189-216). New York  
6 and London: Plenum Press.
- 7 Naderi, S., Miklósi, Á., Dóka, A., & Csányi, V. (2001). Co-operative interactions  
8 between blind persons and their dogs. *Applied Animal Behaviour Science*, 74(1),  
9 59-80. doi:10.1016/S0168-1591(01)00152-6
- 10 Podberscek, A. L., & Serpell, J. A. (1997). Aggressive behaviour in English cocker  
11 spaniels and the personality of their owners. *Veterinary Record*, 141, 73-76.
- 12 Podberscek, A. L., Paul, E., & Serpell, J. A. (2000). *Companion Animals and Us:*  
13 *Exploring the Relationships Between People and Pets* (pp. 1-335). Cambridge,  
14 UK: Cambridge University Press.
- 15 Prato-Previde, E., Custance, D. M., Spiezio, C., & Sabatini, F. (2003). Is the dog-  
16 human relationship an attachment bond? An observational study using Ainsworth's  
17 strange situation. *Behaviour*, 140, 225–254.
- 18 Prato-Previde, E., Marshall-Pescini, S., & Valsecchi, P. (2008). Is your choice my  
19 choice? The owners' effect on pet dogs' (*Canis lupus familiaris*) performance in a  
20 food choice task. *Animal Cognition*, 11(1), 167-74. doi:10.1007/s10071-007-0102-  
21 7
- 22 Robinson, I. (1995). *The Waltham Book of Human–Animal Interaction: Benefits and*  
23 *Responsibilities of Pet Ownership* (pp. 1-148). Kidlington: Pergamon Press.
- 24 Rooney, N. J., Bradshaw, J. W. S., & Robinson, I. H. (2001). Do dogs respond to play  
25 signals given by humans? *Animal Behaviour*, 61(4), 715-722.  
26 doi:10.1006/anbe.2000.1661
- 27 Serpell, James A. (1996). Evidence for an association between pet behavior and owner  
28 attachment levels. *Applied Animal Behaviour Science*, 47(1-2), 49-60.  
29 doi:10.1016/0168-1591(95)01010-6
- 30 Serpell, James A. (2003). Anthropomorphism and Anthropomorphic Selection—  
31 Beyond the “Cute Response.” *Society and Animals*, 11(1), 83-100.  
32 doi:10.1163/156853003321618864
- 33 Thrun, S. (2004). Toward a Framework for Human-Robot Interaction. *Human-*  
34 *Computer Interaction*, 19(1), 9-24. doi:10.1207/s15327051hci1901&2\_2

- 1 Tinya, F., Márialigeti, S., Király, I., Németh, B., & Ódor, P. (2009). The effect of light  
2 conditions on herbs, bryophytes and seedlings of temperate mixed forests in Órség,  
3 Western Hungary. *Plant Ecology*, 204(1), 69-81. doi:10.1007/s11258-008-9566-z
- 4 Topál, J., Miklósi, Á., & Csányi, V. (1997). Dog-Human Relationship Affects Problem  
5 Solving Behavior in the Dog. *Anthrozoös*, 10(4), 214-224.  
6 doi:10.2752/089279397787000987
- 7 Topál, J., Miklósi, Á., Csányi, V., & Dóka, A. (1998). Attachment behavior in dogs  
8 (*Canis familiaris*): A new application of Ainsworth's (1969) Strange Situation  
9 Test. *Journal of Comparative Psychology*, 112(3), 219-229. doi:10.1037/0735-  
10 7036.112.3.219
- 11 Turcsán, B., Kubinyi, E., & Miklósi, Á. (2011). Trainability and boldness traits differ  
12 between dog breed clusters based on conventional breed categories and genetic  
13 relatedness. *Applied Animal Behaviour Science*, 132(1-2), 61-70.  
14 doi:10.1016/j.applanim.2011.03.006
- 15 Turcsán, B., Kubinyi, E., Virányi, Z., & Range, F. (2011). Personality matching in  
16 owner-dog dyads. *Journal of Veterinary Behavior: Clinical Applications and  
17 Research*, 6(1), 77-77. doi:10.1016/j.jveb.2010.09.016
- 18 Wedl, M., Schöberl, I., Bauer, B., Day, J., & Kotrschal, K. (2010). Relational factors  
19 affecting dog social attraction to human partners. *Interaction Studies*, 11(3), 482-  
20 503. doi:10.1075/is.11.3.09wed
- 21 Wickler, W. (1976). The ethological analysis of attachment: Sociometric, motivational  
22 and sociophysiological aspects. *Zeitschrift für Tierpsychologie*, 42(1), 12-28.
- 23 Wilsson, E., & Sundgren, P.-E. (1997). The use of a behaviour test for the selection of  
24 dogs for service and breeding, I: Method of testing and evaluating test results in the  
25 adult dog, demands on different kinds of service dogs, sex and breed differences.  
26 *Applied Animal Behaviour Science*, 53(4), 279-295. doi:10.1016/S0168-  
27 1591(96)01174-4
- 28 Wollenberg, A. L. (1977). Redundancy analysis an alternative for canonical correlation  
29 analysis. *Psychometrika*, 42(2), 207-219. doi:10.1007/BF02294050
- 30



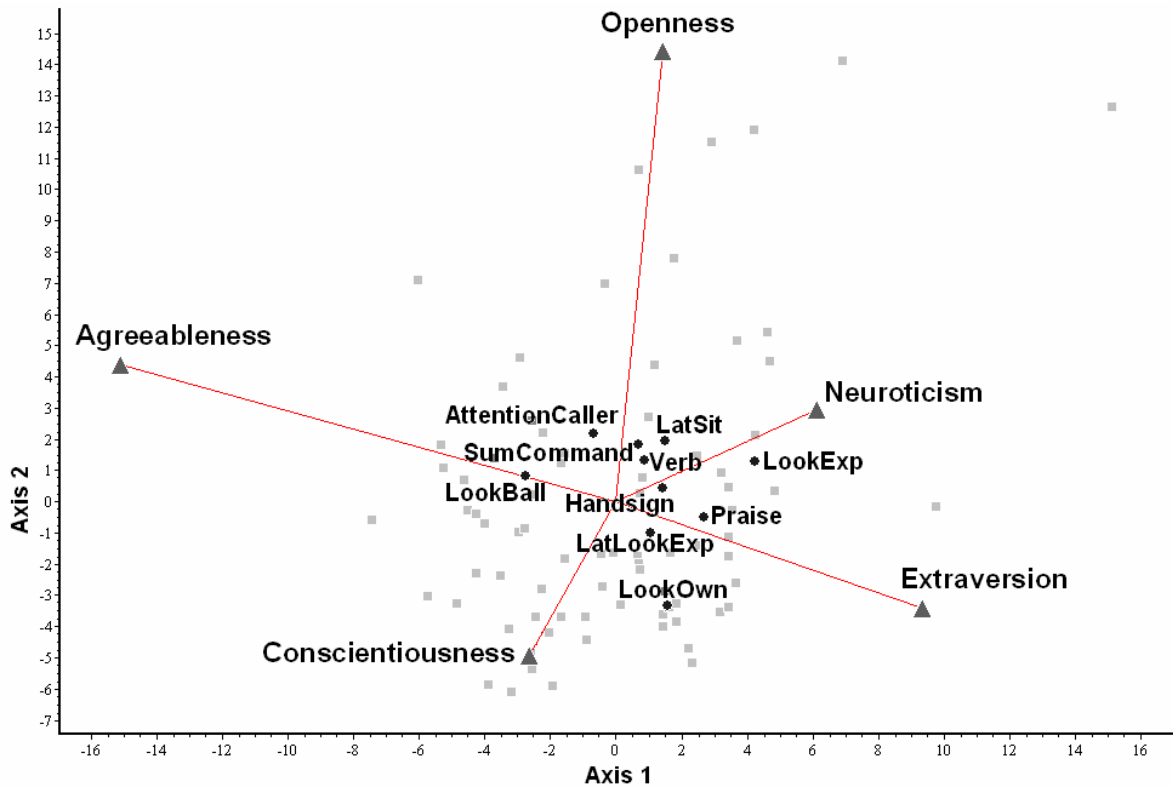
1 **Figure caption**

2 **Table 1.** Variables used in the present study (with the abbreviations in parenthesis

3 where applicable) and the reliability measures in the case of behavioural variables.

Source	Dog	Owner
<i>Personality questionnaire</i>		Neuroticism
		Extraversion
		Openness
		Agreeableness
		Conscientiousness
<i>Phase 1</i>	Latency of accomplishing the command (LatSit), $\kappa = 1$	Total verbal information (SumCommand)
	Time spend looking at owner (LookOwn), $\kappa = 0.9$	Verbs, $\kappa = 0.89$
		Attention getters, $\kappa = 0.9$
		Praise, $\kappa = 0.9$
		Hand signs, $\kappa = 0.85$
<i>Phase 2</i>	Latency to look at the exp. (LatLookExp) , $\kappa = 0.8$	
	Time spend looking at the exp.(LookExp), $\kappa = 0.8$	
	Time spend looking at the ball (LookBall) , $\kappa = 0.8$	

- 1 **Figure 2.** Treeplot showing the results of the Redundancy Analysis. The light grey
- 2 squares are the individual dog-owner pairs, the black circles are the behavioural
- 3 variables observed in Phases 1 and 2 of the social interaction test and the dark grey
- 4 triangles represent the personality factors of the owners. The black circles, which appear
- 5 close to the lines connecting the triangles to the point of zero, indicate close association.



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