Relational factors affecting dog social attraction to human partners

Manuela Wedl[1], Iris Schöberl[1], Barbara Bauer[1],
Jon Day[2] & Kurt Kotrschal[1]
[1]University of Vienna, Austria/[2]WALTHAM Centre for Pet Nutrition, UK

We previously showed (Kotrschal et al., 2009) that owner personality and human–dog relationship predicted the performance of a human–dog dyad in a practical task. Based on the same data set we presently investigate the effects of individual and social factors on the social attraction of dogs to their owners. Twenty-two male and female owners and their intact male dogs were observed during a "picture viewing" test, where we diverted the owner's attention away from their dog whilst it was permitted to move freely around the room. Owner personality axis "neuroticism" and dog personality axis "vocal and aggressive" were, respectively, positively and negatively related to the time the dog stayed in proximity to the owner. Quality of relationship and attachment also had significant effects on this proximity. We conclude that personality and the nature of the human–dog relationship may all influence dogs' social attraction to their owners.

Keywords: companion animals; dog–human attachment; dyadic relationships; human-animal interactions; human–dog attachment; human–dog relationship; human–dog social interactions; personality; pets

1. Introduction

It seems to be uniquely human to engage in (social) relationships with other animals (Podberscek, Paul & Serpell, 2000; Robinson, 1995; Serpell, 1986; Turner & Bateson, 2005; Wilson, 1984). In addition to the wealth of practical benefits that humans may gain from such an association, there may be direct and indirect effects on human health and well-being (Kotrschal & Ortbauer, 2003; Kotrschal, Bromundt & Föger, 2004; Podberscek, Paul & Serpell, 2000; Robinson, 1995; Wilson & Turner, 1998). Companion animals are known to affect humans in a number of ways (Brickel, 1982; Bachmann, 1975; Messent, 1983;

Interaction Studies 11:3 (2010), **482–503**. DOI 10.1075/is.11.3.09wed
ISSN 1572–0373 / E-ISSN 1572–0381 © John Benjamins Publishing Company

McNicholas & Collis, 2000; Mugford & M'Comisky, 1975), and the presence of a dog may trigger positive effects in a classroom, such as increased social integration of children (Kotrschal & Ortbauer, 2003). This is possible because cross-species socialization may be facilitated by a common "social toolbox" (Kotrschal, 2009) which includes conservatively-maintained vertebrate brain-structures and functions (i.e. for social behaviour and emotions; Goodson, 2005; Panksepp, 1998), and a conservative "social physiology" (i.e. hypothalamic-pituitary-adrenal axis and sympathico-adrenergic stress axis; Kotrschal, 2005; McEwen & Wingfield, 2003; deVries, Glasper & Detillion, 2003). In addition, vertebrates share major structural principles of social behaviour.

In dyadic social relationships, partners invest time in each other, may learn from each other, and may collaborate in various ways. For example, social partners, including companion animals, may provide active and passive (i.e. emotional) social support for each other (Aureli & de Waal, 2000; Scheiber et al., 2005), resulting in physiological and health benefits for the human partner (Robinson, 1995; Wilson & Turner, 1998), and potentially also for the animal partner. However, because interests of dyadic partners are neither entirely stable over time, nor symmetrical, dyadic relationships generally fit the "valuable-relationship model", predicting that individual positions in a relationship are dynamically negotiated in cycles of conflict and "reconciliation" (Aureli & de Waal, 2000). This may also be applicable to human–animal dyads. Indeed, relationships between humans and their companion animals are not free of conflicts (McCune, McPherson & Bradshaw, 1995) and may probably be understood in the context of this theoretical framework.

Several studies have shown gender differences in interactions with, and attitudes towards animals (reviewed by Herzog, 2007). In general, women and girls tend to form stronger emotional relationships with their pets than men and boys (Prato-Previde, Fallani & Valsecchi, 2006; Ray, 1982; Rost & Hartmann, 1994; Kotrschal et al., 2009) and girls 3 to 7 years of age seek animal contact more often than boys at the same age (Wedl & Kotrschal, 2009). It has also been shown that the performance of a human–dog dyad in a practical task is predictable from the quality of the dyadic relationship (Kotrschal et al., 2009; Topàl, Miklòsi & Csànyi, 1997). Hence, women owners should have an edge in that respect over men owners.

Topál et al. (1998) investigated dog–human attachment behaviours in a modified version of Ainsworth's (1969) Strange Situation Test (SST); essentially, separation from the caregiver in an unfamiliar environment evokes anxiety in human infants and also in dogs (Topál et al., 1998). This suggests that functional analogies exist between infant and dog attachment (Gácsi et al., 2001; Topal et al., 2005). However,

we suggest that both the bio-psychological and ontogenetic mechanisms of attachment may be similar in humans and dogs, and that individual and dyadic factors will affect mutual social attraction and attachment. Based on the SST approach, Prato-Previde et al. (2003) concluded that the dog–human relationship is a strongly affective bond, but they disputed whether this would satisfy the criteria for attachment and argued that Topal et al.'s (1998) study would not distinguish attachment from a general affective bond. Palmer and Custance (2008) used an improved SST procedure and concluded that the dog–human bond is indeed, consistent with the system of attachment known to exist between human infants and their caretakers.

However, procedural problems make it difficult to apply the SST in a comparative way in animal studies. Furthermore, biologists are usually less satisfied than psychologists with "constructs" and prefer to consider "natural characters" instead (i.e. features which are open to be investigated in a coherent evolutionary frame, at all four levels of Tinbergen (1963)). From this perspective it is reasonable to doubt that "attachment" and "social attraction" label discrete categories. It may be more adequate to view them as different intensities and functional modifications, along a continuum of the brain bonding mechanism (Curley & Keverne, 2005). In an attempt to avoid the methodological problems inherent to an SST approach in its application to dogs, we chose a simple procedure to judge the social attraction of the dog to the owner. However, because this is not fully compatible with attachment theory (Ainsworth, 1969), we generally will refer to social attraction rather than attachment in the present paper. As in this experiment we distracted the owner and monitored how responsive the dog itself was to the owner, this was a test for social attraction rather than attachment.

We previously showed (Kotrschal et al., 2009) that owner personality and relationship to dog, including owner attachment to dog (as judged from questionnaire data), predicted the performance of a human–dog dyad in a practical task. Based on the same data set, we presently ask how the gender of the owner, human and dog personality, human–dog relationship and owner attachment to dog affect dog social attraction within dyads of female and male owners and their intact male dogs. In previous research it has been found that owners scoring high on the neuroticism scale tend to be closely attached to their dogs (Kotrschal et al., 2009). In the present paper, it is hypothesised that the higher an owner scores in neuroticism, the more their dogs would be attracted to them. We also included information from owner questionnaires to see how symmetrical or mutual social attraction would be in our human–dog dyads. Hence, in contrast to previous work, which focussed on the dog mainly, we try to adopt a more dyadic approach. For example, we ask whether attachment on the part of the human

partner and attraction on the dog's part would be symmetrical or whether the dog, for example, might compensate for an overly attached owner by keeping its distance when given the choice. At least in human dyads, relational asymmetry is a well known phenomenon (e.g. Eagle, Pentland & Lazer, 2009). To answer this question, we investigated the relationships that exist between the personality of owner and dog, the quality of owner–dog relationship as well as the owner's sex and the behaviours and interactions of the dyad in the course of the "picture viewing" test. In this test, the owners were distracted using a defined protocol with the objective of regulating the interaction between them and their dog. In particular, we ask whether and how the investigated factors influence the proximity between dog and owner, the orientation of the dog towards its owner and the frequency of the dog's approaches towards the owner in this test situation. We expected that during the experimental conditions of the "picture viewing" test the social attraction of the dog towards its owner, is activated (e.g. proximity and contact seeking behaviours and the maintenance of proximity) by the distracted owner in an unfamiliar room. We suggest that the experimental conditions of the "picture viewing" test may be effective in activating dog distance regulation, which in turn, may be related to dog social attraction. Based on the results of a previous study (Kotrschal et al., 2009), we furthermore hypothesized that the higher an owner scores in neuroticism, the more their dogs would be oriented to their owners, the more often they would approach their owners and the longer they would stay in proximity to their owners during our test.

2. Methods

The current results are based on the same data set as used in a previous paper (Kotrschal et al., 2009). There, the basic relationship patterns were reported, in particular how owner personality affects owner–dog relationship and interactions. Here we report the results of one experiment done in this context, to investigate the social attraction of the dog to its owner. Hence, most of the methods we used were already described in detail and we only report the overall design of the study here and refer to our previous paper concerning the details. Only methods not sufficiently described elsewhere are presently explained in detail. This includes the subjects of the study, the test situations used for personality rating, the "picture viewing" test, and the description of the test room, where this test situation was scheduled.

2.1 Subject recruitment and criteria

We recruited participants by advertisements on the internet, in veterinarian clinics, at dog training facilities, in local newspapers, and by directly approaching dog owners. We checked whether our criteria were met, which were: intact male pet dog, only one dog in the household, dog adopted as pup (maximum 16 weeks), body weight 10 kg or more, age 1.5–6 years; owner aged 18 or older, only main reference person of the dog would participate, and that the dyad was living in the Vienna area. These criteria, served to control variability in the data set, which was particularly important in this case, because only a restricted number of participants could be recruited. For this reason, we consider this as a pilot study.

Owners were informed that saliva samples would be taken from themselves and their dogs (the results of the hormonal analyses will be published elsewhere), and that data collection would be conducted using video recording during three meetings. They were also informed that no one else other than the experimenters would be present during the meetings in addition to themselves and their dog. It was explained to the owner that there would be a series of test situations, mostly mimicking situations which they and their dogs might be confronted with during daily life. They were also told that they could terminate the tests at any time. However, the details of the tests or their goals were not given to the owners ahead of testing.

In addition to those dyads that participated in the full tests, a number of other dog owners were asked only to complete our questionnaires to increase our sample size in human personality, human–dog relationship and human attachment to dog. The criteria for inclusion were the same as applied to our test dyads, except that owner respondents with dogs older than 6 years were also accepted.

2.2 Subjects

Ten male and 12 female dog owners (age 23–68) participated fully in our study with their male dogs. The dogs were medium- or large-sized intact male pet dogs (age 1.5 to 6.0 years, adopted by owners between 7 and 12 weeks of age, weight between 11 and 55 kg, 4 mixed-breeds and 15 different pure breeds (Bearded Collie, Groenendael, Border Terrier, Bullterrier, Cocker Spaniel, Eurasier (2), Golden Retriever (3), Labrador Retriever, Parson Jack Russel Terrier, Pit Bull, Polish Lowland Sheepdog, Polish Tatra Sheepdog, Rough Collie, Tibet Terrier, White Swiss Shepherd Dog). Eighteen other dog owners (6 male, 12 female, age 28–55) completed our questionnaires (dog's age ranged from 1.5 to 9.0 years, dog adopted by owners between 6 and 16 weeks of age, dog weight between 20 and 37 kg, 5 mixed-breeds and 11 different pure breeds (Australian Shepherd (2),

Austrian Pinscher, Border Collie, Dalmatian, Flat-Coated Retriever, Golden Retriever (3), Irish Setter, Magyar Vizsla, Nova Scotia Duck-Tolling Retriever, Rhodesian Ridgeback, Weimaraner).

2.3 General procedure

Data collection was carried out between January & May 2007. A total of three meetings were scheduled with each of the dyads, with an average of 7 days separating the meetings (range 4 to 27 days). Two observers visited each dyad at the owners' home for the first meeting. One of the observers (Iris Schöberl) interacted with the owner, guided the procedure, and explained the questionnaires; the other observer (Manuela Wedl) video-taped the behaviour of both the dog and owner using a hand-held digital camcorder with a wide-angle conversion lens. The second meeting (which included amongst other test situations the "picture viewing" test) and third meeting were scheduled in a specially adapted test room (4.7 m × 7.1 m) at the University of Vienna and were guided by one observer (Iris Schöberl). Tests were recorded by another camcorder fixed on the roof of the test room. The test room had a table, two chairs and a dog blanket. Pictures of human–dog interactions were placed on the windows and walls. Different human–dog interactions, including as well as portraits from dogs were shown in these pictures. The pictures were each located at a level of approximately 160 cm height (centre of the picture). A leash was fixed at the back side of the room, which was needed for two particular test situations. A wire mesh bridge served as room divider, whereby dog and owner stayed only in a 22.09 m^2 sized part (4.7 m × 4.7 m) of the test room during our test situations, except during one particular test situation, where the wire mesh bridge was needed.

2.4 "Picture viewing" test

The "picture viewing" test was scheduled at the beginning of the second meeting. The dog was free to explore the room (which was novel to the dog) and it could seek contact with its owner, who was not specifically instructed how to turn in any way, towards his/her dog and how to react to the dog's contact seeking behaviour before this test situation. The owner was asked to view 15 dog pictures that had been placed on the windows and walls of the experimental room and to write down three words he/she would associate with each of these pictures. The purpose of this was to distract the owner's attention from the dog and to observe the behaviour of dog and owner, particularly towards each other. The owner was allowed ten minutes to complete the task, during which the dog could move freely

within the room. The experimenter was not present during this time. The test situation started when the experimenter left the room and ended 10 minutes afterwards, when the experimenter entered the room again, unless the owner had completed the task prior to that. Mean duration for completing this test situation was 9.4 min (5.5–10.3 min).

The videos that were captured during this test situation were continuously behaviour-coded with the aid of the software package THE OBSERVER Video Pro® (version 5.0, Noldus Information Technology, The Netherlands). Behaviour-coding was performed by two observers ("picture viewing" test: 12 dyads were coded by Iris Schöberl and 10 dyads by Barbara Bauer). For a complete list of coded/rated variables as well for details about the recording method used (for all test situations) see Kotrschal et al. (2009).

For analysis within this paper, three not mutually exclusive variables of the "picture viewing" test were used as dependent variables: (1) "Duration of dog orientated towards the owner" (% of time: dog's head orientated towards the owner which includes the dog sniffing owner, with or without contact), (2) "Duration of dog and owner staying close or next to each other" (% of time: dog within the same one-third sector of the room as the owner, with or without contact), and (3) "Rate of dog approaching the owner" (number per minute: dog moves into reach distance of the owner and appears oriented toward the owner; parallel movements and moving behind in same speed were excluded).

2.5 Human–dog relationship and human attachment to dog

To characterize the quality of attachment and relationship that existed between the owner and the dog, a set of questionnaires was used (translated and modified from the "Questionnaire for Anthropomorphic Attitudes" developed by Topál, Miklósi, and Csányi (1997) and from "The Dog Attitude Scale" developed by Johannson (1999)). The questionnaires were presented at the first meeting to the owners which took part in the experiment, with the request to complete them before the last meeting. These questionnaires were completed by a further 18 other dog owners, who did not participate in our test situations. We included this information in order to gain a dyadic view of the relationship, particularly because most of the previous work concentrated on the dog (see introduction).

2.5.1 *Human attachment to dog*

Principal Component Analysis (PCA; n = 40, Bartlett-Test: KMO = 0.767; Sphericity: $chi^2 = 400.674$, df = 105, $p < 0.001$; Varimax-rotation, Kaiser-normalization), performed with 15 attachment items from the questionnaires mentioned in the section above revealed four main axes: 1. (dog as a) social supporter, 2. (dog as a)

meaningful companion, 3. (dog as a) social partner, 4. (dog as an) understanding partner (Table 1, also see Kotrschal et al., 2009).

Table 1. The factor loadings for human-to-dog attachment (axes 1–4) that resulted from the PCA performed with 15 items. Loadings of 0.500 or above are highlighted in bold text

Items	Principal Components			
	1: Social supporter	2: Meaningful companion	3: Social partner	4: Understanding partner
Just being with my dog makes me feel good	**0.866**	0.320	0.125	0.019
My dog helps to keep me in balance	**0.808**	0.272	0.177	−0.133
It makes me feel better to talk to my dog if I am sad, worried or angry	**0.764**	0.049	0.019	0.393
I like taking care of my dog, the daily routines do not annoy me	**0.685**	0.087	0.284	0.489
It feels good to talk to my dog	**0.662**	0.119	0.410	0.495
If my dog were to get lost, sick, or hurt I would feel very sad	0.157	**0.882**	0.050	0.263
I feel responsible for my dog, and that is fine	0.244	**0.851**	0.131	0.183
My dog means a lot to me	0.165	**0.734**	**0.521**	0.132
My dog is a good buddy or friend	0.276	**0.589**	**0.558**	0.181
My dog is a fully-fledged social partner/family member	0.221	0.201	**0.800**	−0.191
I have a conversation with my dog several times per day	0.397	−0.032	**0.702**	0.319
My dog loves me unconditionally	−0.069	0.249	**0.686**	0.373
My dog knows when I feel sad, worried, or angry	−0.011	0.337	−0.065	**0.743**
I think my dog understands me	0.155	0.075	0.094	**0.711**
I miss my dog whenever we cannot be together	0.195	0.180	0.247	**0.610**

2.5.2 *Human–dog relationship*

A PCA (n = 40, Bartlett-Test: KMO = 0.723, Sphericity: chi^2 = 307.370, df = 91, $p < 0.001$; Varimax-rotation, Kaiser-normalization) was performed with 14 owner–dog relationship items from the questionnaires mentioned in the section above and revealed four main axes: (1) (spend) time together, (2) (take) responsibility, (3) (pay) attention, (4) (shared) activity (Table 2, also see Kotrschal et al., 2009).

Table 2. The factor loadings for human–dog relationship (axes 1–4) that resulted from the PCA performed with 14 items. Loadings of 0.500 or above are highlighted in bold text

Items	Principal Components			
	1: Time together	2: Responsibility	3: Attention	4: Activity
I enjoy spending time with my dog	**0.925**	0.103	0.156	0.059
I spend quite a bit of time with my dog	**0.830**	0.268	0.178	0.146
I like cuddling my dog	**0.815**	0.002	0.094	−0.183
I go for a long walk with my dog or train/play with my dog several times per week	**0.709**	0.233	0.000	0.178
Sometimes, the performance of my dog makes me laugh	**0.641**	0.472	0.181	−0.009
I make sure my dog has water all the time	**0.514**	**0.501**	0.227	−0.411
I am responsible for feeding my dog on a daily basis	0.131	**0.899**	0.183	−0.157
Even if other family members are around, my dog lets me know when he/she wants to go outdoors	0.162	**0.793**	−0.228	0.047
I am the person in my family who usually walks my dog	0.249	**0.736**	0.225	0.207
My dog often wants my attention	0.139	0.220	**0.770**	−0.103
I sometimes look for my dog when I actually need to be doing something else	0.170	−0.186	**0.697**	0.021
I play with my dog several times per day	0.004	0.106	**0.530**	0.131
I always take my dog with me (e.g. workplace, hobbies, holidays, excursions, shopping …)	0.473	0.213	0.124	**0.759**
I like to just 'hang out' and to relax with my dog	**0.568**	0.237	−0.102	**−0.606**

2.6 Human personality

Owner personality was tested via the German version (Borkenau & Ostendorf, 1993) of the NEO-Five Factor Inventory (Costa & McCrae, 1992; McGrae & Costa, 1987, 1989, 1992, 2003), because it integrates the most important human personality features (comp. Eysenck, 1990). The 60-item instrument is designed to measure normal adult personality in five domains: neuroticism, extraversion, openness, agreeableness, and conscientiousness. This is a well established and evaluated, empirical approach, which is highly practicable and fairly compatible

with biological personality theory (Koolhaas et al., 1999). In the present study, this personality test was completed by the owner at the first meeting (for more details see Kotrschal et al., 2009).

2.7 Dog personality

Dog personality was observer-rated (below) in a number of test situations from video tapes:

At the first meeting the researchers entered the home of the owner. Owner–dog interactions and the dog's reaction to the experimenters were observed during the first two minutes. Then the owner was asked to play with the dog for a maximum of three minutes in a way he/she usually does. Finally, the owner was asked to feed the dog as usual. While the dog was eating, the owner was asked to touch it, then to step back, then approach the dog again and take the food away just for a few seconds.

All the other test situations used for personality rating were staged at our experimental room at the University of Vienna.

During the second meeting, the owner was asked to train the dog two novel commands chosen out of a list of ten options and explained by the experimenter. The owner was permitted eight minutes for each training sessions. The experimenter was not in the same room during training. Then, the experimenter performed a "veterinarian check" on the dog in the presence of the owner whilst the dog was located on the blanket in the middle of the room. At the same time the owner was interviewed about the dog's weight, age and breed. The experimenter measured the dog's weight, length, waist and chest circumference, inspected its mouth and teeth, examined its ears and eyes, and touched its entire body, particularly the paws. The owner was asked to behave as he/she wanted, in a way he/she and the dog felt comfortable.

During the third meeting the owner was asked to do a short performance test with the dog featuring the two novel commands trained during the last meeting within the maximum of three minutes being permitted for each command. The owner was told that he/she could abandon the test at any time. During this performance test the experimenter was in the room and recorded this situation using a check sheet. The same performance test was also conducted once at the second meeting, but for personality rating, only the second performance test was used, which was a repeat of the same procedure. Then a wooden bridge/ramp, 5m × 1m × 0.6m (length × width × height) with a wire mesh surface was moved into the middle of the room and assembled in preparation for the next test. The bridge was stored in three separate parts that had to be connected with screws. The owner was asked to lead the dog over the bridge as efficiently and safely as

possible, within a maximum of eight minutes being permitted to complete the task. The owner was told that he/she could terminate the test at any time. Finally, two threat tests were staged. The owner was asked to tether the dog on a long leash fixed on the ground, for security of the experimenter. The experimenter told the owner that something will be done that the dog perhaps would not like, and asked the owner to behave as he/she wants to and would do if something similar happened during daily life. The experimenter did not explain what exactly would happen during this test situation. The experimenter left the room, put on a black long coat with a hood, then re-entered the room, closed the door and knocked three times onto the door to get the dog's attention. As soon as the dog looked into the experimenter's direction, the experimenter started to move towards the dog staring into the dog's eyes or, if this was not possible because the dog avoided the eye contact, staring at the dog's face and stopped moving forward at a certain point, so that the dog could not reach her. From now on the experimenter stared for a period of approximately 30 seconds into the dog's eyes or face. Independent of the dog's reaction, the experimenter averted her head after these 30 seconds and moved away from the marked point to the left corner of the room, which was the opposite of the corner where the dog was fixed with the leash. Here the experimenter waited for two minutes. During this period, the next test situation ("mild threatening with owner absent") was explained to the owner. Then the owner was asked to leave the room with the experimenter and to wait quietly outside the test room. The threatening situation as described above was repeated. If the dog showed an aggressive reaction (barking and/or growling for more than four seconds and/or attacking the experimenter with moving head and/or strained leash (after Vas et al., 2005)) or showed an avoidance reaction (moving away from the experimenter into the back of the room and/or trying to hide), the experimenter moved away from the marked point to the left corner of the room, sat down onto the ground and looked away from the dog while waiting for two minutes. If the dog showed a friendly or neutral reaction (neither aggressive, nor avoidance) the experimenter turned away her head, crossed the marked point to get closer to the dog and squatted down to get in contact with the dog. Then the experimenter left the room to take off the black coat and to go back into the room together with the owner. The experimenter invited the dog to play with her. After this the owner was allowed to let the dog off the leash.

These test situations formed the basis for the dog personality scoring that was conducted following the completion of quantitative behaviours by the two observers (Barbara Bauer and Iris Schöberl). Using an observer rating modified after Feaver, Mendl, and Bateson (1986) each dog was rated in a number of items between two opposing characteristics. The two observers rated all dogs independently from each other after observing the dog's behaviour from tape, during the

situations described above. The position of each rating on a left-to-right scale was measured and transcribed for further analysis. Inter- and intra-observer agreement was tested before and after completion of rating and was higher than 82% for the used personality items. The mean rating given by the two observers was used in subsequent analyses. A PCA was performed on 17 items (n = 22, Bartlett-Test: KMO = 0.673, Sphericity: $chi^2 = 374.158$, df = 136, $p < 0.001$; Varimax-rotation, Kaiser-normalization). This resulted in four main axes: 1. sociable and active; 2. unconfident and anxious; 3. vocal and aggressive 4. clever and attentive (Table 3, also see Kotrschal et al., 2009).

Table 3. The dog personality factor loadings (axes 1–4) that resulted from the PCA performed with 17 items. Loadings of 0.500 or above are highlighted in bold text

Items	Principal Components			
	1: Sociable and active	2: Unconfident and anxious	3: Vocal and aggressive	4: Clever and attentive
Sociable	**0.878**	0.094	−0.298	−0.052
Active	**0.876**	0.374	0.033	0.066
Gladsome	**0.861**	0.271	−0.372	0.103
Interested	**0.852**	0.193	0.239	−0.006
Playful	**0.850**	0.141	−0.264	0.023
Calm and balanced	**−0.768**	−0.490	−0.138	−0.018
Wild	**0.603**	0.403	0.405	−0.141
Confident	−0.252	**−0.922**	−0.002	−0.039
Anxious	0.086	**0.909**	0.145	0.140
Nervous	0.383	**0.792**	0.231	−0.324
Dependable	−0.487	**−0.727**	−0.022	0.310
Vocal	0.064	0.035	**0.856**	−0.289
Aggressive	−0.125	0.234	**0.805**	0.138
Friendly	**0.554**	0.009	**−0.764**	−0.045
Excitable	0.475	**0.525**	**0.528**	−0.234
Clever/smart	−0.039	−0.179	−0.126	**0.917**
Attentive	0.462	0.485	0.088	**0.614**

2.8 Statistical analysis

Data analysis was performed using Noldus Observer 5.0. and SPSS 15.0 (Chicago, IL, USA). General linear models (GLMs) were used to explore whether and how, the investigated factors (owner gender, owner and dog personality, human–dog-relationship and human attachment to the dog) affected the "Duration of dog and

owner staying close or next to each other" [% of "picture viewing" test] and the "Duration of dog orientated towards the owner" [% of "picture viewing" test]. Both dependent variables were normally distributed (Shapiro-Wilk Test for Normality; $p = 0.270$ and $p = 0.105$, respectively) and showed homoscedasticy (homogeneity of variance was tested using the Levene's Test; $p = 0.201$ and $p = 0.815$, respectively). A generalized linear model (GLM) was used to explore whether and how, the investigated factors influenced the "Rate of dog approaching the owner" [rate in "picture viewing" test], because this dependent variable was not normally distributed (Shapiro-Wilk Test for Normality; $p = 0.003$). So we transformed the values by multiplying by 100 and determined the distribution afterwards which approximated a Poisson distribution. So we could conduct a generalized linear model with a log-link function and based on Poisson distribution.

We constructed all three GLMs using the gender of the owner as a factor, and human-to-dog attachment axes 1–4, human–dog relationship axes 1–4, human personality dimensions 1–5 and dog personality axes 1–4 as covariates. We selected these explanatory variables as main effects and removed them in the order of decreasing significance if $p > 0.1$. Only terms with $p < 0.1$ remained in the final models. Excluded terms were re-entered one by one into the final model to confirm that they did not explain a significant part of the variation (Poesel et al., 2006). Although all terms with $p < 0.1$ remained in the final model (according to standard stepwise model reduction procedures) and therefore are presented in the results-section, only terms with $p < 0.05$ were considered as having a significant influence on the dependent variable. We conducted pairwise comparisons with Bonferroni-correction to determine the differences between male and female owners.

3. Results

3.1 Human attachment to dog

The more the owner considered his/her dog as a "social supporter" and as a "meaningful companion" (human attachment PCA-axes 1 and 2), the longer dog and owner were observed to be close or next to each other (Table 4). Also, the more the owner considered the dog as a "social supporter" and an "understanding partner" (human attachment PCA-axes 1 and 4), but the less he/she tended to consider the dog as a "meaningful companion" (human attachment PCA-axis 2), the more often the dog approached the owner during the "picture viewing" test (Table 4). The more the owner considered the dog as a "social partner" (human attachment PCA-axis 3), the less time the dog spent oriented towards its owner (Table 4).

Table 4. Statistics for GLMs 1–3, with 1. "Duration of dog and owner staying close or next to each other" [% of "picture viewing" test], 2. "Duration of dog orientated towards the owner" [% of "picture viewing" test] and 3. "Rate of dog approaching the owner", [rate in "picture viewing" test] as dependent variables. Of the 18 potential explanatory variables analysed using GLM, six had a significant impact on the time that dog and owner stayed close or next to each other, one had a significant impact on the time that the dog spent being orientated towards the owner and all were found to have a significant impact on the relative number of approaches the dog carried out towards its owner during the "picture viewing" test

	GLMs 1-3								
	1: "Duration of dog and owner staying close or next to each other"			**2: "Duration of dog orientated towards the owner"**			**3: "Rate of dog approaching the owner"**		
Explanatory variable	*df*	*F*	*p*	*df*	*F*	*p*	*df*	*Wald statistic*	*p*
"Social supporter" (Attachment PCA-axis 1)	1	19.661	0.001		excluded		1	46.596	< 0.001
"Meaningful companion" (Attachment PCA-axis 2)	1	7.568	0.016		excluded		1	15.684	< 0.001
"Social partner" (Attachment PCA-axis 3)		excluded		1	7.214	0.016	1	32.528	< 0.001
"Understanding partner" (Attachment PCA-axis 4)		excluded			excluded		1	31.536	< 0.001
"Time together" (Relationship PCA-axis 1)	1	31.034	< 0.001	1	3.341	0.085	1	44.157	< 0.001
"Responsibility" (Relationship PCA-axis 2)		excluded		1	4.148	0.058	1	58.056	< 0.001
"Attention" (Relationship PCA-axis 3)		excluded			excluded		1	17.408	< 0.001
"Activity" (Relationship PCA-axis 4)	1	31.127	< 0.001		excluded		1	14.851	< 0.001
Owner gender		excluded			excluded		1	21.752	< 0.001
Neuroticism (Neo-FFI dimension 1)	1	8.023	0.013		excluded		1	17.062	< 0.001
Extraversion (Neo-FFI dimension 2)		excluded			excluded		1	39.879	< 0.001
Openness (Neo-FFI dimension 3)		excluded			excluded		1	59.634	< 0.001
Agreeableness (Neo-FFI dimension 4)		excluded			excluded		1	25.818	< 0.001
Conscientiousness (Neo-FFI dimension 5)		excluded			excluded		1	24.105	< 0.001

(*Continued*)

Table 4. (Continued)

	GLMs 1-3								
	1: "Duration of dog and owner staying close or next to each other"			2: "Duration of dog orientated towards the owner"			3: "Rate of dog approaching the owner"		
Explanatory variable	*df*	*F*	*p*	*df*	*F*	*p*	*df*	*Wald statistic*	*p*
"Sociable and active" (Dog personality PCA-axis 1)		excluded			excluded		1	13.969	< 0.001
"Unconfident and anxious" (Dog personality PCA-axis 2)	1	3.391	0.087	1	3.927	0.064	1	60.505	< 0.001
"Vocal and aggressive" (Dog personality PCA-axis 3)	1	52.903	< 0.001		excluded		1	13.887	< 0.001
"Clever and attentive" (Dog personality PCA-axis 4)		excluded			excluded		1	90.404	< 0.001

3.2 Human–dog relationship

The less important it was for the owner to "spend time with his/her dogs" (relationship PCA-axis 1), to "pay attention to his/her dog" and to "share activity with his/her dog" (relationship PCA-axes 3 and 4), but the more important it was for the owner to "take responsibility" for his/her dog (relationship PCA-axis 2), the more often the dog approached the owner during the "picture viewing" test (Table 4). The more important it was for the owner to "spend time with the dog" (relationship PCA-axis 1), the longer dog and owner were observed to be close or next to each other (Table 4), and the longer the dog tended to be oriented towards the owner (tendency, Table 4). The more important it was for the owner to "take responsibility for his/her dog" (relationship PCA-axis 2), the less time the dog tended to spend being oriented towards the owner (tendency, Table 4). The more important it was for the owners to "share activity with their dog" (relationship PCA-axis 4), the less time dog and owner spent close or next to each other (see Table 4).

3.3 Owner gender and personality

Dogs owned by men approached their owners more often than dogs of female owners (Post-hoc test: $p = 0.011$, Table 4). The higher an owner scored in "neuroticism" (Neo-FFI dimension 1), the longer dog and owner spent close or next to each other (Table 4). The higher the owner scored in "neuroticism", but the lower the owner in the other four NEO-dimensions, the more often the dog approached the owner in the "picture viewing" test (Table 4).

3.4 Dog personality

The more "sociable and active" and "unconfident and anxious" and the less "vocal and aggressive" and "clever and attentive" the dog (dog personality PCA-axes 1–4), the more often the dog approached the owner during the "picture viewing" test (Table 4). The more "unconfident and anxious" the dog (dog personality PCA-axis 2), the less time dog and owner tended to spend close or next to each other (tendency, Table 4) but the longer the dog spent oriented towards the owner (tendency, Table 4). The more "vocal and aggressive" the dog (dog personality PCA-axis 3), the less time dog and owner spent close or next to each other (Table 4, also see Figure 1).

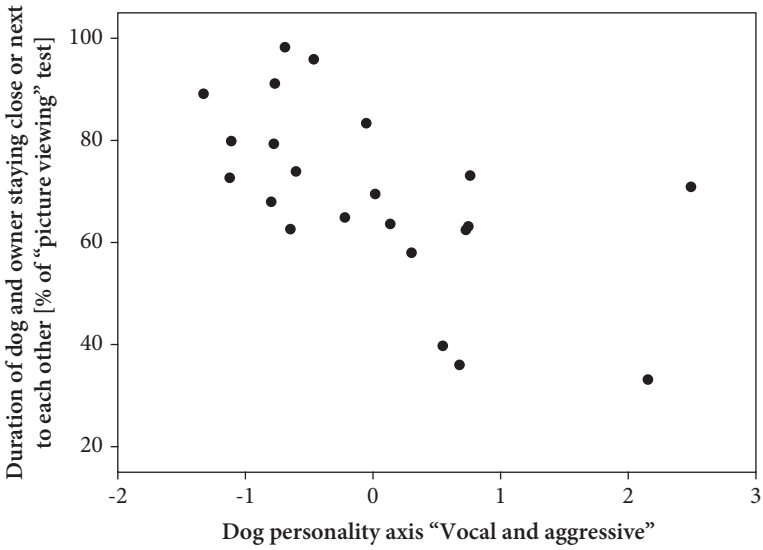

Figure 1. The relationship between the dog personality axis "Vocal and aggressive" (Dog personality PCA-axis 3) and the "Duration of dog and owner staying close or next to each other" [% of "picture viewing" test] ($n = 22$)

4. Discussion

In the present paper we investigated the effects of individual and social factors on the social attraction of dogs to their owners. These factors were the gender of the owner, human and dog personality, human–dog relationship and owner attachment to dog. In particular, we questioned whether and how, the factors influenced the proximity of the dog to its owner, the orientation of the dog towards its owner, and the frequency of the dog's approaches.

As expected, we found that the higher an owner scored in "neuroticism" (Neo-FFI dimension 1), the longer dog and owner spent in proximity to each other and the more often the dog approached his owner. This fits our previous finding that owners scoring high on the neuroticism dimension need their dogs as an emotional social supporter and, hence, are firmly attached to their dogs (Kotrschal et al., 2009). This reflects social attraction of the dog to the owner. Certainly, attachment, as judged from our questionnaire data on the side of the owner coincided with socially attracted dogs.

The other four FFI-dimensions affected the dog's approaches towards the owner in the opposite direction. However, this kind of human attachment and dog social attraction matching did not seem to arise just through a simple adjustment of dog personality to owner personality. In fact, dog personality was an important factor affecting interactions between dogs and their owners during the "picture viewing" test. This indicates that human–dog dyadic relationships are comparable to human dyads, in accordance with Asendorpf and Wilpers (1998) who demonstrated that human personality factors predict a number of aspects in human dyadic relationships.

We found that the dog approached the owner more often when the owner considered it as being a social supporter. In contrast, owners who considered their dog as being a partner and companion seemed to support independent behaviour in the dog. In fact, their dogs were less orientated towards them and approached them less often. These patterns are suggestive of the type of attachment the dogs may have as a base for the kind of social attraction behaviour it showed. Dogs which frequently approach their owners may be insecurely attached. However, it could also be argued that independent behaviour may suggest a secure attachment (Ainsworth, 1969; Topál et al., 1998). When owners considered their dog as being a partner for shared activities, their dog approached them less often and spent less time in proximity to them. This could be suggestive of secure attachment, but further work would be required to fully substantiate this assertion. Owner personality may affect owner behaviour in a way that either supports or inhibits social attraction in dogs. For example, owners scoring high on neuroticism may mainly regard their dogs as being a social supporter (Kotrschal et al., 2009) and thus, will frequently interact with them and reinforce spatial closeness with their dogs.

Based on the results of previous studies that have detected sex differences in interaction style and attitudes towards pets (Ray, 1982; Paul & Serpell, 1992; Rost & Hartmann, 1994; Prato-Previde, Fallani & Valsecchi, 2006; Herzog, 2007; Kotrschal et al., 2009; Wedl & Kotrschal, 2009), we expected that owner gender would be an important determinant of dog social attraction. Topál et al. (1998) did not find effects of gender, age, living conditions, or breed on most of the behavioural variables in a dog version of the SST. However, in our "picture viewing" test we found that owner gender can be a factor. But we only found an effect of owner

gender on how often the dog approached its owner. Because this was a pilot study, we just included intact male dogs in this study. With a greater sample size and including also female dogs we would expect that on the one hand dog sex and on the other hand, the combination of owner gender and dog sex would affect dog response variables.

In conclusion, our findings indicate that owner gender, owner and dog personalities, and the nature of the human–dog relationship may all influence dog attraction to their owner. These findings are also relevant for a better understanding of the human–dog relationship and may benefit successful pet ownership. For example, dog training hitherto mainly emphasizes techniques. The message from our studies (this one and Kotrschal et al. 2009) is that dog trainers should individualize dyadic training depending on dog and owner relationship and personalities.

Acknowledgements

Financial and logistic support was provided by IEMT Austria. M.W. was supported by a research fellowship of the University of Vienna (F-403 Forschungsstipendium). We thank the dog owners and dogs whose participation made this study possible. We would also like to thank John Dittami for his help and support at the planning stage of this project. Finally we are grateful to Brigitte Weiss for statistical support and Zsófia Virányi and three anonymous referees for their critical reading of a previous version of this article.

References

Ainsworth, M.D.S. (1969). Object relations, dependency and attachment: a theoretical review of the infant–mother relationship. *Child Development,* 40, 969–1025.

Asendorpf, J.B. & Wilpers, S. (1998). Personality effects on social relationships. *Journal of Personality and Social Psychology,* 74, 1531–1544.

Aureli, F. & de Waal, F.B.N. (2000). *Natural conflict resolution*. Berkley: University of California Press.

Bachmann, R.W. (1975). Elementary school children perception of helpers and their characteristics. *Elementary School Guidance and Counseling,* 10, 103–109.

Borkenau, P. & Ostendorf, F. (1993). *NEO-Fünf-Faktoren Inventar (NEO-FFI) nach Costa und McCrae*. Göttingen: Hogrefe.

Brickel, C.M. (1982). Pet facilitated psychotherapy. A theoretical explanation via attention shifts. *Psychological Reports,* 50, 71–74.

Costa, P.T. & McCrae, R.R. (1992). *Revised NEO Personality Inventory (NEO PI-R) and NEO Five-Factor Inventory (NEO-FFI): Professional Manual*. Lutz, Florida: Psychological Assessment Resources.

Curley, J.P. & Keverne, E.B. (2005). Genes, brains and mammalian social bonds. *Trends in Ecology and Evolution*, 20, 561–567.

DeVries, C.A., Glasper, E.R. & Detillion, C.E. (2003). Social modulation of stress responses. *Physiology and Behavior*, 79, 399–407.

Eagle, N., Pentland, A. & Lazer, D. (2009). Inferring friendship network structure by using mobile phone data. *Proceedings of the National Academy of Sciences of the United States of America*, 106, 15274–15278.

Eysenck, H.J. (1990). Biological dimensions of personality. In L.A. Pervin (Ed.), *Handbook of personality: theory and research*, (pp. 244–276). NY: Guilford Press.

Feaver, J., Mendl, M. & Bateson, P. (1986). A method for rating the individual distinctiveness of domestic cats. *Animal Behaviour*, 34, 1016–25.

Gácsi, M., Topál, J., Miklósi, Á., Dóka, A. & Csányi, V. (2001). Attachment behaviour of adult dogs (Canis familiaris) living at rescue centres: Forming new bonds. *Journal of Comparative Psychology*, 115, 423–431.

Goodson, J.L. (2005). The vertebrate social behaviour network: Evolutionary themes and variations. *Hormones and Behavior*, 48, 11–22.

Herzog, H.A. (2007). Gender differences in human–animal interactions: A review. *Anthrozoös,* 20, 7–21.

Johannson, E.E. (1999). *Human–animal bonding: an investigation of attributes*. Ph.D. Thesis, University of Alberta, Edmonton.

Koolhaas, J.M., Korte, S.M., Boer, S.F., Van Der Vegt, B.J., Van Reenen, C.G., Hopster, H., De Jong, I.C., Ruis, M.A.W. & Blokhuis, H.J. (1999). Coping styles in animals: current status in behavior and stress-physiology. *Neuroscience Biobehavior Review*, 23, 925–935.

Kotrschal, K. (2005, August). *Why and how vertebrates are social: physiology meets function*. Plenary contribution at the IEC, Budapest, Hungary.

Kotrschal, K. (2009). Die evolutionäre Theorie der Mensch-Tier-Beziehung. In C. Otterstedt & M. Rosenberger (Ed.), *Gefährten – Konkurrenten – Verwandte. Die Mensch-Tier-Beziehung im wissenschaftlichen Diskurs* (pp. 55–77). Göttingen: Vandenhoeck & Ruprecht.

Kotrschal, K., Bromundt, V. & Föger, B. (2004). *Faktor Hund. Eine sozio-ökonomische Bestandsaufnahme der Hundehaltung in Österreich*. Wien: Czernin-Verlag.

Kotrschal, K. & Ortbauer, B. (2003). Behavioral effects of the presence of a dog in a classroom. *Anthrozoös,* 16, 147–159.

Kotrschal, K., Schöberl, I., Bauer, B., Thibeaut, A.-M. & Wedl, M. (2009). Dyadic relationships and operational performance of male and female owners and their male dogs. *Behavioural Processes,* 81, 383–391.

McCrae, R.R. & Costa, P.T. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of Personality and Social Psychology,* 52, 81–90.

McCrae, R.R. & Costa, P.T. (1989). Rotation to maximize the construct validity of factors in the NEO Personality Inventory. *Multivariate Behavioral Research,* 24, 107–124.

McCrae, R.R. & Costa, P.T. (1992). Discriminant validity of NEO-PIR facet scales. *Educational and Psychological Measurement*, 52, 229–237.

McCrae, R.R. & Costa, P.T. (2003). *Personality in adulthood*. Second edition. NY: Guilford Press.

McCune, S., McPherson, J.A. & Bradshaw, J.W.S. (1995). Avoiding problems. In I. Robinson (Ed.), *The Waltham Book of Human–Animal Interactions* (pp. 71–86). Kidlington: Pergamon Press.

McEwen, B.S. & Wingfield, J.C. (2003). The concept of allostasis in biology and biomedicine. *Hormones and Behavior*, 43, 2–15.

McNicholas, J. & Collis, G.M. (2000). Dogs as catalysts for social interactions: Robustness of the effect. *British Journal of Psychology,* 91, 61–70.

Messent, P.R. (1983). Facilitation social interaction by companion animals. In A.H. Katcher & A.M. Beck (Eds.), *New Perspectives on Our Lives with Companion Animals* (pp. 37–46). Philadelphia: University of Pennsylvania Press.

Mugford, R.A. & M'Comisky, J.G.M. (1975). Some recent work on the psychotherapeutic value of cage birds with old people. In R.S. Anderson (Ed.), *Pet Animals and Society* (pp. 54–65). Springfield: IL.

Palmer, R. & Custance, D. (2008). A counterbalanced version of Ainsworth's Strange Situation Procedure reveals secure-base effects in dog–human relationships. *Applied Animal Behaviour Science,* 109, 306–319.

Panksepp, J. (1998). *Affective Neuroscience. The foundations of human and animal emotion*. NY: Oxford University Press.

Paul, E.S. & Serpell, J. (1992). Why children keep pets: the influence of child and family characteristics. *Anthrozoös,* 5, 231–244.

Podberscek, A.L., Paul, E. & Serpell, J.A. (Eds.). (2000). *Companion animals and us: Exploring the relationships between people and pets*. Cambridge, UK: Cambridge University Press.

Poesel, A., Kunc, H.P., Foerster, K. & Kempenaers, B. (2006). Early birds are sexy: male age, dawn song and extrapair paternity in blue tits, Cyanistes (formerly Parus) caeruleus. *Animal Behaviour,* 72, 531–538.

Prato-Previde, E., Custance, D.M., Spiezio, C. & Sabatini, F. (2003). Is the dog–human relationship an attachment bond? An observational study using Ainsworth's strange situation. *Behaviour,* 140, 225–254.

Prato-Previde, E., Fallani, G. & Valsecchi, P. (2006). Gender Differences in Owners Interacting with Pet Dogs: An Observational Study. *Ethology,* 112, 63–73.

Ray, J.J. (1982). Love of animals and love of people. *Journal of Social Psychology,* 116, 299–300.

Robinson, I. (1995). *The Waltham Book of Human–Animal Interaction: Benefits and responsibilities of pet ownership*. Kidlington: Pergamon Press.

Rost, D.H. & Hartmann, A. (1994). Children and their pets. *Anthrozoös,* 7, 242–254.

Scheiber, I.B.R., Weiss, B.M., Frigerio, D. & Kotrschal, K. (2005). Active and passive social support in families of Greylag geese (*Anser anser*). *Behaviour,* 142, 1535–1557.

Serpell, J.A. (1986). *In the company of animals*. Oxford: Basil Blackwell.

Tinbergen, N. (1963). On aims and methods of ethology. *Zeitschrift für Tierpsychologie*, 20, 410–433.

Topál, J., Gácsi, M., Miklósi, Á., Virányi, Zs., Kubinyi, E. & Csányi, V. (2005). Attachment to humans: a comparative study on hand-reared wolves and differently socialized dog puppies. *Animal Behaviour*, 70, 1367–1375.

Topàl, J., Miklòsi, À. & Csànyi, V. (1997). Dog–human relationship affects problem solving behavior in the dog. *Anthrozoös,* 10, 214–223.

Topàl, J., Miklòsi, À., Csànyi, V. & Dóka, A. (1998). Attachment behavior in dogs (Canis familiaris): A new application of Ainsworth's (1969) strange situation test. *Journal of Comparative Psychology,* 112, 219–229.

Turner, D.C. & Bateson, P. (Eds.). (2005). *The Domestic Cat*: (2nd ed.). Cambridge: Cambridge Univ. Press.

Vas, J., Topál, J., Gácsi, M., Miklósi, A. & Csányi, V. (2005). A friend or an enemy? Dogs' reaction to an unfamiliar person showing behavioural cues of threat and friendliness at different times. *Applied Animal Behaviour Science*, 94, 99–115.

Wedl, M. & Kotrschal, K. (2009). Social and individual components of animal contact in preschool children. *Anthrozoös* 22, 383–396.
Wilson, C.C. & Turner, D.C. (Eds.). (1998). *Companion animals in human health*. London: Sage.
Wilson, E.O. (1984). *Biophilia*. Harvard: Harvard University Press.

Authors' addresses

Manuela Wedl (corresponding author)
Konrad Lorenz Research Station
and Department of Behavioural Biology
University of Vienna
Althanstraße 14
1090 Vienna
Austria

Email: manuela.wedl@univie.ac.at

Iris Schöberl
Konrad Lorenz Research Station
and Department of Behavioural Biology
University of Vienna
Althanstraße 14
1090 Vienna
Austria

Email: der.hund.und.du@gmail.com

Barbara Bauer
Konrad Lorenz Research Station
and Department of Behavioural Biology
University of Vienna
Althanstraße 14
1090 Vienna
Austria

Email: bauerbarbara@gmx.at

Jon Day
WALTHAM Centre for Pet Nutrition
Freeby Lane
Waltham-on-the-Wolds
Melton Mowbray
Leicestershire LE14 4RT
UK

Email: jon.day@eu.effem.com

Kurt Kotrschal
Konrad Lorenz Research Station
and Department of Behavioural Biology
University of Vienna
Althanstraße 14
1090 Vienna
Austria

Email: kurt.kotrschal@univie.ac.at

About the authors

Manuela Wedl is a doctoral student and scientific assistant at the Department of Behavioural Biology of the University of Vienna, Austria. She received her diploma in Zoology from the University of Vienna, in 2006. Her research interests focus on human–animal relationships, human–animal interactions and the role of personality traits in these contexts.

Iris Schöberl is a Ph.D. researcher in human–animal relationship at the University of Vienna, Austria. She received her diploma for Biology at the University of Vienna, Department of Behavioural Biology in 2009. Her research interests are human–animal relationship, behavioural endocrinology, animal assisted intervention and human psychology.

Barbara Bauer received her diploma in Zoology from the University of Vienna, Austria in 2007. As a diploma student she worked on the relationship between humans and cats. Afterwards she was a research assistant at the Department of Behavioural Biology of the University of Vienna until June 2008. Since 2007 she has been working as a biology teacher.

Jon E.L. Day leads the Behavioural Sciences at the WALTHAM Centre for Pet Nutrition. He gained a B.Sc. (hons) in Applied Zoology from the University of Reading in 1992 and a Ph.D. in Applied Ethology from the University of Edinburgh in 1995. His research interests include human/animal interaction, and the behavioural nutrition of dogs and cats with a particular emphasis on learning and motivation.

Kurt Kotrschal, Ph.D., is Associate Professor at the University of Vienna Dept. Behav. Biol. and director of the Konrad Lorenz Forschungsstelle in Grünau. His active research is at the interface of social complexity, physiological mechanisms and cognition in birds and mammals. Based on this he has recently developed interest into human–animal relationships.

Copyright of Interaction Studies is the property of John Benjamins Publishing Co. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.