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Owner perception of dog stress and dog behavioural and physiological stress parameters in experimental situations.

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1. Zusammenfassung

Eine lange gemeinsame Geschichte von Mensch und Hund sowie deren außergewöhnlichen Gemeinsamkeiten in physiologischen und psychologischen Mechanismen haben ein gegenseitiges Verständnis zwischen Mensch und Hund erleichtert (Vila et al. 1997, Panksepp 1998; Goodson 2005; Kotrschal 2009; Wang et al. 2013). Folglich könnte man davon ausgehen, dass Halter gute Fähigkeiten im Interpretieren von Hundeverhalten haben. Hundetrainer berichten jedoch häufig vom Gegenteil. Die Fähigkeit der Halter Verhaltensindikatoren von Stress zu erkennen kann helfen, das Wohlergehen sowie Verhaltensprobleme ihrer Hunde zu verbessern. Das Ziel dieser Studie war die Untersuchung folgender Faktoren: (1) die Fähigkeiten von Hundehaltern das Verhalten ihrer Hunde einzuschätzen, (2) den Einfluss der Beziehung und Bindung zu den Hunden, der Persönlichkeit des Halter, sowie deren Geschlecht und Alter auf die Wahrnehmung ihrer Hunde und (3) die Beziehung zwischen Verhaltensindikatoren von Stress der Hunde und Ausschüttungen des Stresshormons Kortisol. Verhaltens- und Fragebogendaten, sowie Speichelproben für Kortisolmessung wurden innerhalb von drei Treffen gesammelt. Insgesamt nahmen 132 Mensch-Hund-Teams an unseren Experimenten teil und 1414 weitere Hundehalter beantworteten unsere Online-Fragebögen. Unsere Ergebnisse zeigten, dass Hundehalter das stressbedingte Verhalten ihrer Hunde gut einschätzen können. Um das Befinden des Hundes beurteilen zu können, zogen die Hundehalter Verhaltensindikatoren wie Vokalisation (Bellen, Winseln, Knurren, Heulen), Hecheln und Körperkontakt des Hundes zum Halter heran. Die Wahrnehmung war jedoch von der Beziehung zum Hund, der Persönlichkeit, dem Geschlecht und dem Alter der Hundehalter beeinflusst. Weibliche Halter nahmen ihre Hunde als gestresster wahr als männliche Hundehalter. Weiters wurde die Wahrnehmung der Hunde von den Persönlichkeitsmerkmalen Verträglichkeit, Extraversion und Neurotizismus der Halter beeinflusst. Folglich gehen wir davon aus, dass die Beurteilung von Hundeverhalten beziehungsweise Hundepersönlichkeit durch reine Fragebogenstudien stark von diesen Faktoren beeinflusst ist. Darüber hinaus fanden wir Korrelationen zwischen dem Bindungsverhalten des Hundes (Vokalisation, Körperkontakt zum Halter) und deren Kortisolausschüttung.

Diese neuen Einblicke in die Wahrnehmung von Hundehaltern werden eine Hilfestellung für HundeverhaltensberaterInnen sein, um diese im Umgang mit ihren Hunden besser beraten zu können.

Schlagwörter: Persönlichkeit, Mensch-Hund Beziehung, Stressmanagement, Subjektivität, Kortisol, Stressverhalten, Bindungsverhalten

2. Abstract

A long shared history and striking similarities in physiological and psychological mechanisms may facilitate mutual understanding between humans and dogs (Vila et al. 1997, Panksepp 1998; Goodson 2005; Kotrschal 2009; Wang et al. 2013). Hence, one would expect that owners would be well able to interpret dog behaviour, but dog trainers often experience the opposite. The owners' ability to estimate their dogs' well-being by recognizing behavioural signs of stress might help to improve welfare and behaviour problems of dogs. Therefore the aim of this study was to investigate (1) the accuracy of pet dog owners rating their dogs' mental state during potentially stressful situations, (2) the influence of owner-dog relationship, attachment, owner personality, gender and age on the perception of the own dog and (3) the relationship between behavioural indicators of stress and cortisol modulation of the dog. Behavioural and questionnaire data as well as saliva samples for cortisol measurement were collected during three meetings. We had 132 owner-dog dyads participating in our experimental study and 1414 pet dog owners completing our online questionnaires. Our results suggest that owners have a realistic view on their dogs' stress-related behaviour. The indicators of stress considered by the owners were the duration of vocalizing (barking, whimpering, growling, howling, screaming), panting and body contact to the owners. But still, the owners' perception of their own dog is influenced by their gender, age, personality and relationship. Female owners judged their dogs as being more stressed than male owners. Also, owners who scored high in agreeableness, but low in neuroticism and extroversion perceived their dogs' stress level as higher than owners low in agreeableness, but high in neuroticism and extroversion. Therefore we conclude that by the assessment of dog behaviour or dog personality by questionnaires only, these owner-related aspects are highly reflected. Furthermore we found attachment-related dog behaviour (vocalization and body contact to the owner) to be linked to cortisol modulation. The new insights in the owners' perception of their dogs might improve dog behaviour counsellors advising owners on dealing with problematic behaviour of their dogs.

Key words: personality, human-dog relationship, stress coping, cortisol, subjective rating, stress-related behaviour, attachment behaviour

3. Introduction

Humans and dogs share a long history (Vila et al. 1997, Wang et al. 2013) and show striking similarities in brain structures as well as physiological and psychological mechanisms (e.g. bonding, emotions, stress coping; Panksepp 1998; Goodson 2005; Kotrschal 2009). These aspects may facilitate mutual understanding between humans and dogs. The owners' ability to estimate their dogs' well-being by recognizing behavioural signs of stress might help to avoid welfare problems (Mariti et al. 2012) and to improve behaviour problems and dog training. It was found that stress hormones decrease thresholds for aggressive behaviour, which, in turn, may raise stress hormones (Kruk et al. 2004); therefore stress level might also be linked to problematic behaviour in dogs. Stressors and stress hormones, also negatively affect social cognition and memory retrieval (Roozendaal 2002; Kuhlmann, Piel and Wolf 2005). Hence, a stressed dog and a stressed owner may not be the best combination for effectively handling a critical situation.

The hypothalamic–pituitary–adrenal axis (HPA) is a core element of the neuroendocrine system. It is the master system regulating metabolism and also responding to all kinds of stressors, from physical to social, in order to balance the steady state of body and mind. Functionally, the HPA system is therefore, an anti-stress system (Koolhaas et al. 2011). HPA activation, in response to a stressor up-regulates steroid hormone, more specifically glucocorticoid synthesis (cortisol in dogs and humans). Cortisol is produced by the adrenal gland and its' release is controlled by the hypothalamus. Both, bodily pain and mental dysbalance can activate the HPA-axis (McIntyre et al. 1999; Horváth et al. 2007). Known triggers of psychological stress include a novel/unfamiliar environment (Bassett, Cairncross and King 1973; Hennessy et al. 1997; Palestrini et al. 2005), a threatening environment (e.g. electric shock: Friedman et al. 1967; sound blast: Beerda et al. 1998) or a separation from an attachment figure (Bowlby 1969; Ainsworth and Bell 1970; Ahnert et al. 2004; Palestrini et al. 2005). The more unpredictable and uncontrollable a situation, the more severe will a stress response and its psycho-physiological consequences be (Weiss 1970; Beerda et al. 1998; Koolhaas et al. 2011). HPA up-regulation makes body and mind ready for action and also, for leaving. Behavioural responses of dogs, as well, differ according to different types of aversive stimuli (Beerda et al. 1998). It

is still very difficult to determine whether and to what extent a dog is stressed. Many factors might be involved in finally determining the behavioural or physiological stress response. Numerous behavioural parameters might be considered for analysing (Pastore et al. 2011). Furthermore, the relationship between behavioural stress indicators and glucocorticoid levels is not well established (Beerda et al. 1998). The HPA-axis needs activation to allow supplying of activated tissues with metabolites during physical activity. Hence, it is not always clear if cortisol levels are increased as a result of a stress response or rather behavioural physical activity (Koolhaas et al. 2011). But there is also an antagonistic calming system (Uvnäs-Moberg 1998) to the HPA stress system: Oxytocin is a peptide hormone, mainly synthesized in the hypothalamic paraventricular nucleus, which is released during social contact and is associated with social bonding. Oxytocin inhibits cortisol synthesis at different levels and thereby, supports positive relationships and health (Heinrichs et al. 2003; Detillion et al. 2004; Beetz et al. 2011; Julius et al. 2012). Brief socio-positive interactions with humans may increase oxytocin levels in both, dog and owner (Handlin et al. 2011) and may reduce the plasma cortisol levels and stress-related behaviours in shelter dogs (Hennessy et al. 1998; Shiverdecker, Schiml and Hennessy 2013).

The severity of a stress response not only depends on current social contact but also on the quality of the attachment bond to parents, formed during early childhood (Ahnert et al. 2004). When stressed, individuals tend to seek close contact to the attachment figure. Separation from the attachment figure causes distress. Offspring attachment behaviour and parental caregiving behaviour are closely linked. Crying, for example, will normally solicit caregiving behaviour (Ainsworth 1964, Bowlby 1969). Such psycho-physiological mechanisms of the attachment and caregiving behavioural systems may not only work in mother-offspring relationships but may also be relevant for dog-human relationships (Topál et al. 1998; Gácsi et al. 2001; Palmer and Custance 2008; Gácsi et al. 2013). Securely attached dogs may seek close contact to their owners when becoming distressed and in return, a responsive owner will offer comfort. According to attachment theory, the attachment behavioural system is solely activated by distress (Bowlby 1969). Hence, it would be expected that responsive owners are sensitive not only to proximity-seeking behaviour but also to stress-related behaviour of their dogs.

Some studies have suggested that owners might have a realistic view on their dogs' behaviour and are able to recognize behavioural signs of stress, at least less subtle ones (Konok et al. 2011, Mariti et al. 2012, Mirkó et al. 2013), but dog trainers more often than none also experience the opposite. Furthermore Mariti et al. (2012) found by questionnaires, that owners who recognize also subtle stress signs, more frequently perceive their dog as being medium or high stressed. This could indicate that some dog owners are more than others tuned to, and sensitive of stress in their dogs. But it remains unclear if such owners are more attentive/interested in interpreting their dogs' behaviour and therefore, rate their dog as more stressed, or if their dogs indeed, have higher stress levels. Kerswell et al. (2009) investigated the relationship between puppy owners' self-reported comprehension of their dogs' emotional state and the dog behaviours they used to judge their dogs' emotional state. In most cases, the comprehension of their emotional state was not related to the number of reported behaviours. Hence, these results may reflect the owners' knowledge gap of dog behaviour. This may not be either or, because it seems that owners' rating would be affected by both, their perception and interpretation (Mirkó et al. 2013).

It has recently been shown that dog owners' personality and gender affect human-dog interaction style, dyadic achievement in practical tasks and dogs' social attraction to their owners (Kotrschal et al. 2009; Wedl et al. 2010; Kis et al. 2012). Schöberl et al. (2012) found that dogs of owners high in neuroticism had lower morning salivary cortisol values. However, owner personality may not only be associated with the variation of human-dog interaction style, dyadic relationship and stress modulation. It may also affect the perception of a situation. Personality, among others, influences the sensitivity to sensory information. People with low emotional stability (i.e. high in neuroticism) are believed to be more sensitive and anticipating towards unpleasant sensory information and are faster at evaluating contexts and situations (Stelmack, Houlihan and McGarry-Roberts 1993; Wilson et al. 2000). Also, emotional evaluation and attribution is a central process in the forming and updating of mental representations; it may facilitate perception and the speed and priority arousing information is processed (Öhman, Flykt and Esteves, 2001; Vuilleumier and Schwartz 2001; Phelps, Ling and Carrasco 2006). Furthermore, the satisfaction with social relationships is influenced by the ability to monitor the others emotions,

behaviour and needs. Satisfaction with relationships was found to be positively correlated with emotional intelligence and extroversion, negatively with neuroticism (Lopes, Salovey and Straus 2003). If personality traits are indeed, influencing the perception of relationships with others, it can be assumed that this is also valid for owner-dog relationships. There will be individual differences in how owners see their dogs and how they perceive and interpret the situational context and behaviour of their dogs. However, Bennett and Rohlf (2007) investigated relationships between problematic behaviours of dogs and demographic variables and found that participants not primarily responsible for the dog considered it to be more disobedient and unfriendly/aggressive than did participants who were solely responsible or shared responsibility with another person. Hence, this may be an indication of the human-to-dog relationship influencing the perception of the dogs' behaviour.

Most studies on owner-dog relationship, dog behaviour and dog personality rely on questionnaire studies (Hsu and Serpell 2003; McGreevy and Masters 2008; Kubinyi, Turcsán and Miklósi 2009). We hypothesize that owner personality modulates the relationship to the dog and affects the perception of the own dog's behaviour. Hence, questionnaire studies only may highly reflect owner-related aspects. Therefore, we want to investigate the association between observer behaviour coding and rating and the owners' perception of their dogs' behaviour during potentially stressful experimental tests. Furthermore, we want to reveal which owner-related aspects, as owner characteristics, personality and relationship to the dog, might account for the varying owner perception and interpretation of their dogs' behaviour. Additionally, we want to examine the owners' ideal consumption of the own dogs' ability to cope with stress and the relationship between behavioural indicators of stress and cortisol modulation.

4. Methods

4.1. Subjects

For experimental testing during three lab meetings 132 human-dog dyads were recruited via ads in the media (internet, newspapers, television). These 132 human-dog dyads participated in the first and second lab meeting, 59 of these participants attended the third lab meeting. In addition, 1414 dog owners completed our online questionnaires (Tab. 1). Following criteria had to be met to participate in our experimental testing: intact dog (not neutered or spyed) kept as pet dog, adopted as a pup (mean adopting age ± SD: 9.77 ± 3.50 weeks), dog body weight at least 12 kg (mean body weight ± SD: 29.53 ± 13.19 kg; weight range: 12-80 kg), dog age 1.5 to 8 years. Mongrels as well as breeds were accepted, but not more than four individuals of one breed to exclude a potential breed effect. Pet dog owners had to be the main caretakers for their dogs and lived with no other dogs in the household. These criteria had not to be met for the participants of our online survey. Therefore sexually intact as well as neutered or spyed dogs were included. Dogs (mean body weight ± SD: 22.90 ± 13.19 kg; weight range: 1.5-86 kg) were adopted as pups as well as adults (mean adopting age ± SD: 19.80 ± 30.78 weeks). In addition, 31% of our online survey participants lived in a single-dog household, 69% in a multi-dog household. Owners of more than one dog were asked to answer the questionnaires relating to the dog with which they had the closest relationship.

Tab. 1. Number and mean age of the owners and their dogs participating in our experimental study and our online survey.

Sample	♀/♀	♂/♂	♀/♂	♂/♀	Total	Owner mean age ± SD (years)	Dog mean age ± SD (years)
Experiment	35	35	31	31	132	43.76 ± 10.71	3.96 ± 1.83
Online	626	125	544	119	1414	40.07 ± 13.43	5.37 ± 3.40

4.2. Data collection

Human-dog dyads were observed in a number of test situations in three meetings from January 2012 to April 2013 (mean interval ± SD of first and second meeting: 15.4 ± 9.4 days; mean interval ± SD of second and third meeting: 258.3 ± 89.1 days). The owners were fully informed and gave their written consent. All meetings were supervised by one experimenter. Test situations conducted during the first and second meeting included: (1) a separation of the dog from the owner; (2) a “picture”

task where the owners freely associated to images on the wall while their dogs were unrestrained; (3) a “bridge” task where the dogs were lead over a wire mesh bridge; (4) a playing situation where the owners were asked to play with their dogs as usually; (5) a resting phase where the dogs should stay in a relaxed position while interacting was allowed and (6) a mild threat test, carried out in two runs. Two, for this study relevant testing situations will be explained in detail. The separation test was scheduled at the beginning of the first meeting. The experimenter and the owner with his/her dog entered the experimental room and the owner was asked to say goodbye to the dog if desired after unleashing the dog. After the experimenter and the owner left, the dog was left alone in a novel experimental room and was free to explore for three minutes while the owner watched the dog from outside via monitor. For the separation test data of 130 human-dog dyads was analysed. The mild threat test was scheduled at the end of the second meeting. The owner was told before that something would happen which the dog probably does not like while he/she should behave as usually. Then the leashed dog, in presence of the owner, was confronted by a mildly threatening person in a black gown moving slowly towards the dog while staring into its face. The threat test was conducted two times, once in the presence and once in the absence of the owner, in a counterbalanced order. For this study only the threat test in the presence of the owner (124 dyads) was analysed.

Owner and dog behaviour as well as owner dog interaction was videotaped. Later behaviour was rated and coded from these tapes by four coders with The Observer XT10 Noldus©. Behavioural variables of the different testing situations were coded either as states (duration in seconds) or events (frequency in rate per minute) and observer-rated on a 5-point Likert scale. Mean inter- and intra-observer agreement (Cohen’s Kappa) on states, events as well as on ratings were above 0.74 (Tab. 2). Analysed dyadic interaction and stress-related behaviour as well as stress-related observer ratings are described in detail in Tab. 3.

Tab. 2. Mean inter- and intra-observer agreement (Cohen's Kappa) of behavioural variables coded as states or event and observer ratings.

Behaviour analysis	Inter-observer (mean Cohen's Kappa ± SD)	Intra-observer (mean Cohen's Kappa ± SD)
States	0.97 ± 0.01	0.98 ± 0.03
Events	0.74 ± 0.01	0.80 ± 0.15
Ratings	0.78 ± 0.04	0.86 ± 0.06

Tab. 3. Variables coded and rated by the observers (only for these study relevant variables). Variables were coded as event (e) or state (s), rated on a 5-point scale.

Behaviour class	Behaviour variable	Behaviour variable description
Observer-coded variables		
Dog approach and orientation	Dog approach (e)	Dog moves to owner within reach distance (1 meter distance maximum) of owner and appears oriented towards him/her.
	Dog orientation (s)	Dog is orientated towards owner/threatening person. An imaginary line can be drawn from dog's sagittal plane to owner's/threatening person's body.
Dog interaction	Dog body contact (s)	Dog nudges owner with its muzzle, reaches out with forepaw towards owner, leans or rubs body or part of body against owner including leaping with body contact.
Dog locomotion	Dog locomotion (s)	Dog is in motion (includes walking forwards, backwards and side wards, scurrying on the same spot and turnarounds; at least two legs in motion). Dog is trotting/running (moves in jogging gait or moves in gallop).
Dog comfort head	Dog panting (s)	Dog pants with open mouth.
	Dog comfort head (e)	Dog licks lips or nose. Dog yawns.
	Dog sniffing (s)	Dog sniffs floor, chair, table or other objects.
Dog body posture	Dog body posture not neutral (s)	Dog shows impressing body posture, insecure body posture or passive submission.
Dog vocalization	Dog vocalizing (s)	Dog is vocalizing with a maximum break of two seconds in between. Dog is barking (with high to low tones with long rhythmic stanzas, mouth opened or closed). Dog is whimpering (soft, intermittent sounds, with closed to easy opened mouth). Dog is growling (low, guttural, menacing sound, with or without showing the teeth). Dog is howling (a long, high sound with little to wide open mouth). Dog is screaming (a long, high sound, but with no regularity,a hysterical uncoordinated sound).
Dog door/leash related behaviour	Dog closeness to door (s)	Dog is next to door, within reach.
	Dog door scratching (e)	Dog scratches door or jumps at door.
	Dog leash tensed (s)	Dog leash is tensed.
Owner interaction	Owner resolute interactions (e)	Owner thumps (short slap by striking out with the hand), grasps (shaking the dog's neck, tugging/pulling on the dogs skin, holding the muzzle) or forces the dog in position (owner brings the dog with pushing, pulling, lifting, dragging in a special position).

		Owner gives a break-off command (a command to interrupt dog's behaviour).
	Owner socio-positive interactions (e)	Owner nuzzles/kisses or praises (well done/good dog/fine) the dog.
	Owner commanding (e)	Owner calls the dog, gives a task command or a hand signal.
	Owner talking (s)	Owner directly talks to dog (maximum break of two seconds).
Observer-rated variables		
Dog mental state	Dog arousal behaviour	1: very stressed 2: rather stressed 3: passive 4: rather relaxed 5: very relaxed
	Dog reaction to threat	1: aggressive 2: very avoidant 3: rather avoidant 4: passive 5: friendly

4.3. Questionnaires

A self-developed questionnaire was used to collect demographic data and dog training-related questions. A Principal Component Analysis (Training methods PCA), based on all respondents (lab participants and online), including 13 dog training-related questions rated on a 5-point Likert scale (1: never; 5: very often), revealed two axis: (1) positive training methods; and (2) negative training methods (PCA, n=1534, KMO=0.75, Varimax-rotation, 41.6 % of the variability in the data set explained by the two axes; Tab. 4).

Tab. 4. Factor loadings of "Training methods PCA" (self-developed; PCA: n=1534, KMO=0.75, Varimax-rotation, 41.6 % of the variability in the data set explained by the two axes).

Degree of owner agreement/disagreement to the questions	Axis 1: positive training methods	Axis 2: negative training methods
How often do you use following dog training methods: distracting with toys or treats?	**.749**	.001
How often do you use following dog training methods: playing?	**.727**	-.012
How often do you use following dog training methods: giving food?	**.723**	-.055
How often do you use following dog training methods: toys?	**.719**	.042
How often do you use following dog training methods: treats?	**.680**	-.044
How often do you use following dog training methods: praising verbally?	**.506**	-.019
How often do you use following dog training methods: jerking on the leash?	-.045	**.717**
How often do you use following dog training methods: punishing verbally?	.129	**.691**
How often do you use following dog training methods: forcing the dog in a desired position?	-.023	**.640**
How often do you use following dog training methods: forcing the dog to the ground?	-.031	**.604**
How often do you use following dog training methods: shaking the dog's neck?	-.062	**.575**
How would you react if a strange dog approached your dog on the street? I am verbally punishing my dog if it pulls on the leash to get closer to the other dog.	.029	**.465**
How would you react if a strange dog approached your dog on the street? I am pulling it closer into my control area, holding it on a short leash until the strange dog passes.	-.062	**.464**

Furthermore, owners (lab participants) answered a questionnaire after completion of each meeting containing questions, amongst others, about how stressful the owners perceived each of the test situations for themselves and how stressful they believed it was for their dogs (1: not at all stressful; 5: very stressful). To measure human personality of the lab participants, a German version of the NEO-Five-Factor-Inventory (Costa and McCrae 1992, Borkenau and Ostendorf 1993) was used. This well established and validated questionnaire includes 60 items and measures five personality dimensions: neuroticism, extroversion, openness, agreeableness and conscientiousness (Körner et al. 2008).

To investigate the owners' relationship and attachment to the dogs of all respondents (lab participants and online) the Animal Relations Questionnaire (ARQ; Beetz and Ascione 2004; poster) was used. The English version consists of two parts: (1) part A is based on the Inventory of Parent and Peer Attachment (IPPA; Armsden and Greenberg 1987) and was adapted for human-dog-relationships; (2) part B is based

on the Relationship Questionnaire (RQ;Bartholomew and Horowitz 1991) and was adapted for human-dog-attachment styles. A Principal Component Analysis (Relationship to dog PCA), for part A of the ARQ, including 13 items rated on a 5-point Likert scale (1: strongly disagree; 5: strongly agree) revealed three axes: (1) social support; (2) communication; and (3) alienation (PCA, n=1535, KMO=0.83, Varimax-rotation, 53.8 % of the variability in the data set explained by the three axes; Tab. 5). When conducting a principal component analysis (Attachment to dog PCA) for part B of the ARQ, including 13 items rated on a 5-point Likert scale (1: strongly disagree; 5: strongly agree) as well, four axis were found: (1) secure-caregiving; (2) secure; (3) unsecure-ambivalent; and (4) unsecure-distant (PCA, n=1535, KMO=0.77, Varimax-rotation, 56.0 % of the variability in the data set explained by the four axes; Tab. 6).

Tab. 5. Factor loadings of "Relationship to dog PCA" (ARQ part A; PCA: n=1535, KMO=0.83, Varimax-rotation, 53.8 % of the variability in the data set explained by the three axes).

Degree of owner agreement/disagreement to the questions	Axis 1: Social support	Axis 2: commun-ication	Axis 3: alienation
My dog understands my feelings.	**.754**	.170	-.101
My dog feels when I am sad or angry.	**.752**	-.039	-.025
When my dog senses that I am upset about something, it tries to comfort me.	**.749**	.307	-.092
My dog respects my feelings.	**.593**	.267	-.164
When I am sad or angry about something, my dog is there for me.	**.548**	**.458**	-.224
I can count on my dog when I need to get something off my chest.	**.427**	**.642**	-.133
I tell my dog about my problems and troubles.	.164	**.880**	.061
Sometimes I tell my dog about what crosses my head.	.107	**.877**	.050
I often get angry with my dog.	-.094	.075	**.660**
I get upset easily when I am with my dog.	.127	-.038	**.654**
My dog accepts me as I am. (reversed)	-.194	-.233	**.537**
I don't get much attention from my dog.	-.173	.092	**.471**
My dog is a good friend. (reversed)	-.362	-.333	**.413**

Tab. 6. Factor loadings of "Attachment to dog PCA" (ARQ part B; PCA: n=1535, KMO=0.77, Varimax-rotation, 56.0 % of the variability in the data set explained by the four axes).

Degree of owner agreement/disagreement to the questions	Axis 1: secure-caregiving	Axis 2: secure	Axis 3: unsecure - ambivalent	Axis 4: unsecure-distant
I like being there for my dog.	**.797**	.090	-.075	-.005
I am comfortable about my dog meaning a lot to me.	**.711**	.273	.005	-.133
I like caring for my dog.	**.695**	-.064	-.103	.016
I am comfortable taking responsibility for my dog.	**.681**	.052	-.116	.005
I like having a special relationship with my dog.	**.500**	.399	.048	-.189
I want a very close relationship with my dog.	**.488**	**.498**	.074	-.181
My dog cherishs my desire to care for it and to protect my dog.	.137	**.732**	.044	-.101
I often want to do something good for my dog (e.g. feeding, stroking).	.052	**.724**	-.101	.095
I worry that my dog does not love me as much as I love it.	-.051	.036	**.843**	.114
I think that my dog gives me not as much love as I would like.	-.132	-.054	**.828**	.055
It is difficult for me to be emotionally dependent on my dog.	-.040	-.054	.055	**.738**
It is very important to me to feel independent of my dog.	-.002	-.293	.013	**.667**
I worry that I will be hurt if I allow myself to become too close to my dog.	-.108	.282	.138	**.577**

To investigate the owners' attitude towards the importance of aspects of dog well-being (lab participants), a self-developed questionnaire was used (Tab. 7). Owners rated on a scale from 1 to 5, with 1 as "not important for my dog's well-being" and 5 as "very important for my dog's well-being". By conducting a Principal Component Analysis (Well-being PCA), we found 4 axes including 11 items: (1) allround well-being; (2) friendly interactions; (3) stressmanagement; and (4) toughness (PCA, n=59, KMO=0.63, Varimax-rotation, 67.0 % of the variability in the data set explained by the four axes; Tab. 6)..

Tab. 7. Factor loadings of "Well-being PCA" (self-developed; PCA: n=59, KMO=0.63, Varimax-rotation, 67.0 % of the variability in the data set explained by the four axes).

Degree of owner agreement/disagreement to the question: "How important do you think is following aspect for your dog's well-being: …?"	Axis 1: all-round well-being	Axis 2: friendly interactions	Axis 3: stress management	Axis 4: toughness
Getting along with other dogs	**.807**	.207	.105	-.102
Healthy food	**.741**	-.184	.197	-.093
Healthy nutritional condition	**.729**	.106	.106	.297
Outdoor exercise	**.628**	.388	.007	.144
Contact to other dogs	**.544**	.145	.034	-.378
Time to relax	**.418**	.241	.277	**-.524**
Friendly handling	.148	**.851**	-.055	.081
Playing together	.079	**.778**	.242	-.180
Balance	.153	-.022	**.868**	-.093
Good stress coping	.096	.175	**.819**	.198
Being able to manage difficult situations	.141	.057	.172	**.854**

4.4. Saliva samples

Salivary cortisol is known to correlate with plasma cortisol in dogs, while being exposed to less handling stress during sample collection (Beerda et al. 1996). Furthermore the handling in order to get the samples does not affect cortisol responses when the sample can be taken within four minutes (Kobelt et al. 2003).For measuring owner and dog salivary cortisol, the owners collected samples of their dogs and themselves in a twenty minute interval during the two meetings. In fact, 20 minutes were found to be plenty of time to measure cortisol increase after venepuncture in dogs (Hennessy et al. 1998). For collecting salivary cortisol samples, owners chewed on a sterile polypropylene gauze for more than 30 seconds. Meanwhile, owners showed their dogs some food for activating salivation. Cheese was therefore used as it is known not to trigger an unpredictable variation in salivary cortisol measurement (Ligout et al. 2009, oral presentation). Then owners placed a sterile polypropylene gauze in the dogs' buccal cavity for more than 30 seconds. To check baseline cortisol levels, samples were also taken on control days. For analysing cortisol levels of both, dog and owner saliva samples, enzyme immunoassays (EIA) were used. For further statistical analysis of salivary cortisol, instead of absolute values, differences in cortisol levels before as well as 20 minutes after the testing situations (Delta CORT) were used. Delta CORT is calculated as the difference between the cortisol levels before the testing situations and the cortisol levels after the testing situations. Positive levels indicate an increase in salivary

cortisol levels, negative values a decrease. To calculate Delta CORT for the separation test we had 116 valid dog and owner cortisol levels , for the threat test 98 valid dog cortisol levels and 113 valid owner cortisol levels.

4.5. Statistical analysis

With the aid of PASW® statistics 18, non-parametric Mann-Whitney U-test and parametric t-test as appropriate, were used to investigate effects of owner gender and dog sex. For correlating Delta CORT and dog behaviour as well as stress perception, non-parametric Spearmans rank correlation and parametric Pearson correlation were employed. For data reduction of the questionnaires, principal component analyses (PCA) were conducted.

By carrying out two Generalized Linear Models (GLMs), effects of demographics, dog behaviour, owner personality and owner-dog relationship on the owners' perception of the dogs' stress level during threat test as well as separation test were investigated. The GLMs were calculated with following ordinal dependent variables: owner-rated stress level of the own dog during the separation test (GLM 1) and owner-rated stress level of the own dog during the threat test (GLM 2). Both GLMs were constructed with owner gender as factor, as well as owner age, human personality dimensions (1-5), relationship to dog axes (1-3) and stress and owner interaction related behaviour of the dog as covariates (Tab. 8). These explanatory variables were stepwise removed according to decreasing significance, afterwards one by one re-entered into the final model in order to confirm that they did not explain a significant proportion of the variation. All variables with $p<0.1$ remained in the final model (Poesel et al.2006, Schöberl et al. 2012).

Tab. 8. Stress-related behaviour and interaction behaviour of the dog, as included in the Generalized Linear Models (GLMs).

Behavioural variables of GLM1 (separation test)	Behavioural variables of GLM2 (threat test)
Dog panting	Dog panting
Dog comfort head	Dog comfort head
Dog vocalization	Dog vocalization
Dog locomotion	Dog locomotion
Dog sniffing	Dog leash tensed
Dog door scratching	Dog body posture not neutral
Dog closeness to door	Dog orientation to owner
	Dog orientation to threatening person
	Dog approach
	Dog body contact

5. Results

5.1. Effects of owner and dog sex on behavioural and physiological stress parameters of the dogs

Cortisol modulation in the dogs, in response to the separation and threat test, was not related to owner or dog sex. In contrast, dogs behaved differently depending on their male or female owners. Dogs of male owners panted more (Mann-Whitney-U: n=130, Z=-2.902, p=0.004) and tended to show more locomotion (walking, trotting and running; t-test: n=130, t= 1.911, p=0.058) than dogs of female owners during separation test, which may be regarded as behavioural indication of stress. But this was not confirmed by the dogs' salivary cortisol. During the threat test dogs of male owners were more orientated toward the threatening person (Mann-Whitney-U: n=124, Z=-2.068, p=0.039; Fig. 1) and tended to be less orientated toward their owners (Mann-Whitney-U: n=124, Z=-1.920, p=0.055) than dogs of female owners.

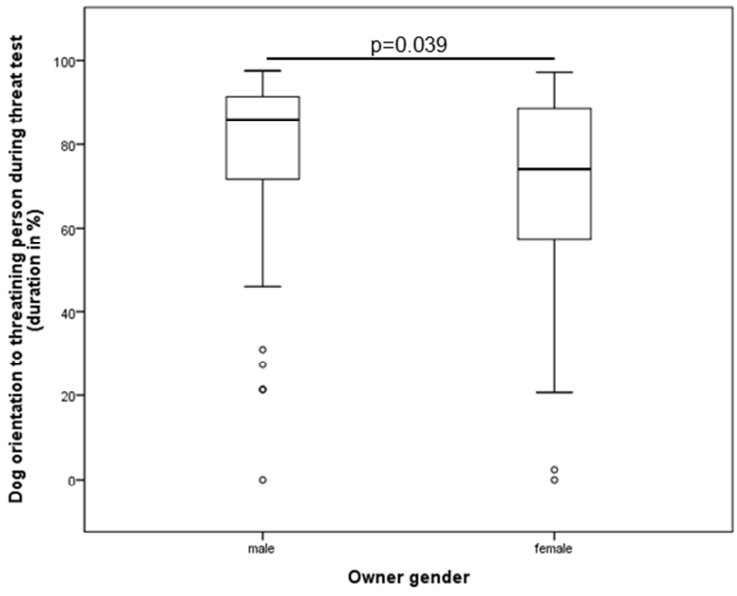

Fig. 1. Duration (%) of dogs, of male and female owners, being orientated to the threatening person during threat test.

It remains unclear whether these results are a direct consequence of differences in male and female owner interaction styles. Male and female owners did not differ in the frequency of commanding (calling, giving a task command or hand signal; Tab. 3), initiating resolute interactions (thumping, grasping, forcing the dog in a position,

giving a break-off command; Tab. 3) and socio-positive interactions (nuzzling/kissing, praising; Tab. 3). However women talked more to their dogs (t-test: n=124, t=-2.227, p=0.025) during the threat test.

Behaviour of male dogs differed from that of female dogs. Male dogs sniffed more (Mann-Whitney-U: n=130, Z=-2.023, p=0.043) during separation test. During threat test the leash of male dogs was tensed for longer periods of time (Mann-Whitney-U: n=124, Z=-2.892, p=0.004; Fig. 2).

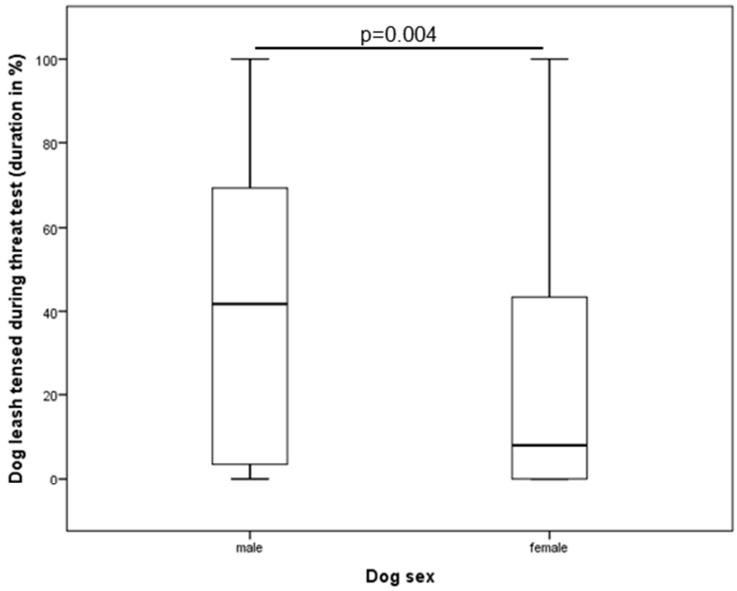

Fig. 2. Duration (%) of male and female dogs' leash being tensed during threat test.

5.2. Behavioural and physiological stress parameters of dogs

During the separation test, 48 of 116 (41.38%) dogs showed a decrease in salivary cortisol, while 68 of 116 (58.62%) showed an increase in this test situation (Fig. 3). During the threat test, salivary cortisol decreased in 50 of 98 (51.02%) dogs and increased in 48 of 98 (48.98%) dogs (Fig. 4).

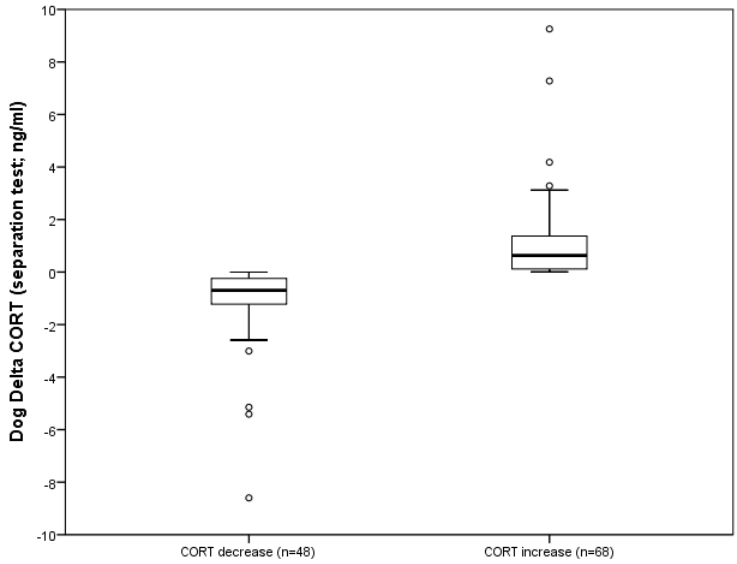

Fig. 3. Dog Delta CORT during separation test. Negative values indicate a decrease in salivary cortisol (n=48), positive values an increase (n=68).

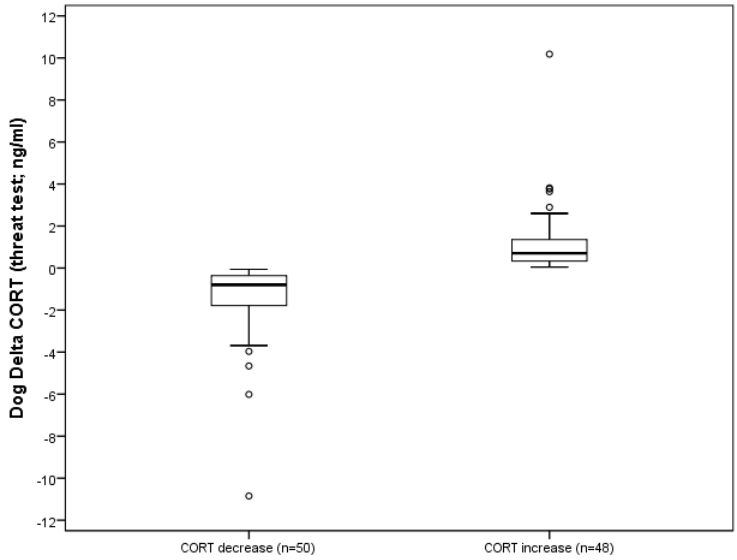

Fig. 4. Dog Delta CORT during threat test. Negative values indicate a decrease in salivary cortisol (n=50), positive values an increase (n=48).

Cortisol modulation of the dog was generally found to be linked to dog behaviour, although typical behaviours thought to be indicative of stress, such as panting, comfort head behaviour (licking and yawning) as well as locomotion (walking, trotting, running) were not correlated with salivary Delta CORT, neither during separation nor threat test. However, the more the dogs vocalized (barking, whimpering, growling,

howling, screaming; Tab. 3) during separation test, the higher Delta CORT (Spearmans: n=115, r_s=0.265, p=0.004). Interestingly, the more the dogs approached their owners during the threat test, the higher Delta CORT (Spearmans: n=96, r_s=0.221, p=0.030).

5.3. Behavioural and physiological stress parameters of the dogs and the owners' perception of the dogs' stress levels

The owners' perception of their dogs' stress level was not linked with their dogs' cortisol modulation but with the observer-rated arousal behaviour during separation and the intensity of the dogs' reaction to the threat (below). However, owners perceiving the threat test as more stressful for themselves, tended to show greater Delta CORT than owners who perceived the situation as less stressful (Spearmans: n=113, r_s=0.184, p=0.051). During the separation test the owners' perceived stress levels of themselves were not related with their cortisol modulation. The higher the observer-rated arousal of the dog during separation and intensity of reaction to the threat the higher were the stress levels of the dogs perceived by their owners (Spearmans: separation test: n=130, r_s=0.365, p<0.001; threat test: n=123, r_s=0.350, p<0.001). The observer-rated arousal and the reaction of the dogs to the threat were not related with the owners' perceived stress levels of themselves. The higher the perceived stress levels of the owners, the higher also the owners' perceived stress levels of their dogs (Spearmans: separation test: n=132, r_s=0.547, p<0.001; threat test: n=126, r_s=0.485, p<0.001).

5.4. Owner demographics, owner personality, owner-dog relationship and dog behaviour and relationship with the owners' perception of the dogs' stress levels during the separation test

The owners' perception of their dogs' stress level during the separation test was generally related to owner gender, owner personality, owner-dog relationship and dog behaviour. Female owners judged their dog as being more stressed than male owners (p=0.004). Furthermore, owners who scored high in agreeableness (Neo-FFI dimension 4) or low in extroversion (Neo-FFI dimension 2) perceived their dogs' stress level as higher during separation test (p=0.033 and 0.022) than owners who scored low in agreeableness or high in extroversion. Also, the higher the owners

scored on the “alienation” scale (Relationship to dog PCA axis 3) the more the owners considered their dogs as being stressed by the separation (p=0.012). Dogs which were panting and vocalizing (barking, whimpering, growling, howling, screaming; Tab. 3) a lot and spent much time next to the door were considered by their owners as being more stressed than dogs which showed these behaviours less often or for less time respectively (p=0.021; p<0.001 and p<0.001; Tab. 9).

Tab. 9: Owner demographics, owner personality, owner-dog relationship and dog behaviour and relationship with the owners’ perception of the dogs’ stress levels during the separation test (Generalized linear model 1 with “owner-rated stress level of the own dog during the separation test” as dependent variable).

Explanatory Variable	*df*	F		p
Owner gender	1	8.241		0.004
Extroversion (Neo-FFI dimension 2)	1	4.567		0.033
Agreeableness (Neo-FFI dimension 4)	1	5.277		0.022
"Alienation" (relationship to dog PCA axis 3)	1	6.328		0.012
Dog panting (duration)	1	5.305		0.021
Dog vocalization (duration)	1	25.186	<	0.001
Dog being next to door (duration)	1	13.116	<	0.001

5.5. Owner demographics, owner personality, owner-dog relationship and dog behaviour and relationship with the owners’ perception of the dogs’ stress levels during the threat test

The owners’ perception of their dogs’ stress level during the threat test was generally related to owner gender, owner age, owner personality, owner-dog relationship and dog behaviour. Female owners as well as young owners perceived their dogs’ stress level as higher than male owners and owners of older age (p=0.022 and p=0.026). Owners who scored low in neuroticism (Neo-FFI dimension 1) considered their dogs as being more stressed by the threat test (p=0.033) than owners high in neuroticism (Neo-FFI dimension 1). Such a trend was also found in owners high on the agreeableness scale (Neo-FFI dimension 4; p=0.056). The higher the owners scored on the “alienation” scale (Relationship to dog PCA axis 3) the higher the dogs were rated as being stressed by their owners (p=0.004). Furthermore, the less often dogs showed comfort behaviour, licking and yawning, the higher the perceived stress level (p=0.025). Dogs which vocalized (barking, whimpering, growling, howling, screaming; Tab. 3) a lot and searched for prolonged body contact to the owner were considered

as being more stressed than dogs which showed these behaviours for less time during the threat test ($p<0.001$ and $p=0.042$; Tab 10).

Tab. 10. Owner demographics, owner personality, owner-dog relationship and dog behaviour and relationship with the owners' perception of the dogs' stress levels during the threat test (Generalized linear model 2 with "owner-rated stress level of the own dog during the threat test" as dependent variable).

Explanatory Variable	df	F	p
Owner gender	1	5.209	0.022
Owner age	1	4.944	0.026
Neuroticism (Neo-FFI dimension 1)	1	4.535	0.033
Agreeableness (Neo-FFI dimension 4)	1	3.649	0.056
"Communication" (relationship to dog PCA axis 2)	1	3.020	0.082
"Alienation" (relationship to dog PCA axis 3)	1	8.521	0.004
Dog comfort head behaviour (licking, yawning) (frequency)	1	5.027	0.025
Dog vocalization (duration)	1	15.218	< 0.001
Dog body contact to owner (duration)	1	4.141	0.042

5.6. Owner demographics, owner personality and owner-dog relationship and relationship with the dogs' actual behavioural and physiological stress parameters during the separation and threat test

When being separated from the owner, 40% of the dogs became rather aroused, 22% were rather relaxed, 20% showed a passive reaction, 13% were very relaxed and 5% very aroused (Fig. 5). During the threat test 31% of the dogs showed a passive reaction (neither avoidant, aggressive nor friendly behaviour), 29% a rather avoidant reaction, 24% an aggressive reaction, 11% a friendly reaction and 4% showed a strong avoidant reaction to the threatening person (Fig. 6). Interestingly, neither owner gender and personality nor relationship to the dog correlated with the observer-rated arousal behaviour during separation, the intensity of the dogs' reaction to the threat as well as the Delta CORT of the dogs, but dogs of older owners showed a less intense reaction to the threat (Spearmans: $n=121$, $r_s=-0.202$, $p=0.026$) than those of younger owners.

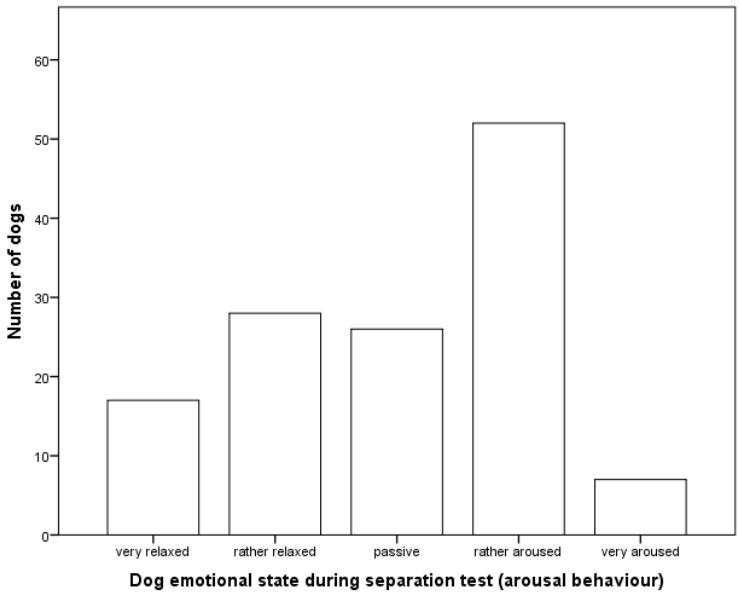

Fig. 5. Emotional state of dogs during separation test as arousal behaviour.

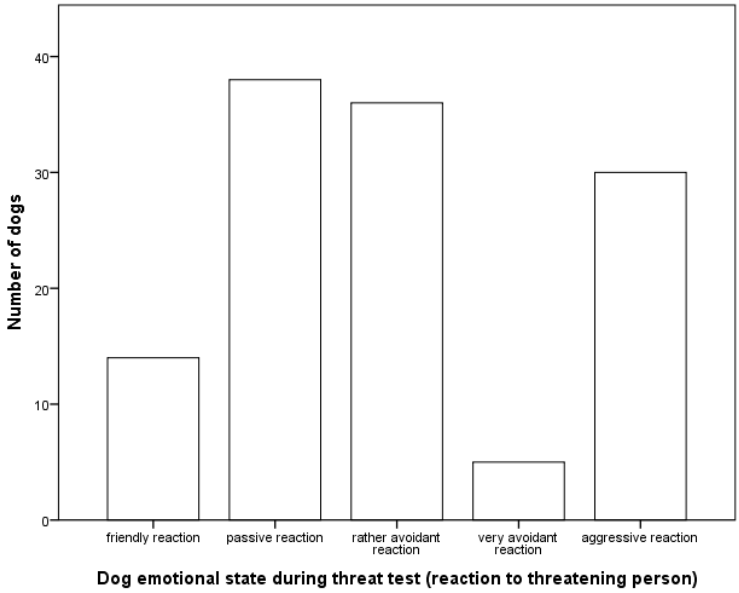

Fig. 6. Emotional state of dogs during the threat test as reaction the the threatening person.

5.7. Stress management and well-being

The owners' attitude of how much they consider a good stress management of their dogs as important for their dogs' well-being (well-being stress scale; Well-being PCA axis 3) was not related with the observer-rated arousal behaviour and reaction to the threat as well as Delta CORT of the dog during the separation and threat test. However, the "well-being stress scale" (Well-being PCA axis 3) was generally related

to the owners' personality, owner-dog relationship and the owners' dog training methods (below). The more the owners considered a good stress management of their dogs as important for their dogs' well-being (Well-being PCA, axis 3), the more time the dogs spent next to the door during separation test (Pearsons: n=59, r_p=0.325, p=0.012) and the less the dogs vocalized (barking, whimpering, growling, howling, screaming; Tab. 3) during threat test (Spearmans: n=59, r_s=0.291, p=0.026). Owners, who scored low in neuroticism (Neo-FFI dimension 1) rated a good stress management of their dogs (Well-being PCA axis 3) as more important than owners, who scored high in neuroticism (Pearsons: n=59, r_p=-0.271, p=0.038). Furthermore, the higher the owners scored on the "well-being stress scale" (Well-being PCA axis 3) the higher the owners scored on the attachment scale "secure-caregiving" (Attachment to dog PCA axis 1; Spearmans: n=58, r_s=0.339, p=0.009) and the less often they use negative training methods (Training methods PCA axis 2; Spearmans: n=59, r_s=-0.272, p=0.037).

6. Discussion

Our results confirm previous findings that owners are able to make a fair estimate of their dogs' behaviour. The more arousal behaviour the dogs showed during the testing situations the more the owners considered them as being stressed. The indicator of stress most considered by the owners was the duration of vocalizing, during separation test as well as threat test. Although functional analogies were found between dog and human nonprimary auditory cortex (Andics et al. 2014), for humans verbal communication might be a more important communication tool whereas dogs may be more sensitive to body language. Also the dogs' physical contact to their owners was considered by the owners when estimating the dogs' stress level and might suggest that owners are sensitive not only for stress-related vocalization, but also for the dogs' need for a safe haven when feeling threatened. Furthermore we found that vocalization of the dog when being separated from the owner as well as the frequency of approaching the owner while being threatened by a strange person to be related to dog cortisol modulation. Concerning the correlation of Delta CORT and frequency of approaching behaviour of the dog during the threat test, one could argue that this result might be a consequence of increased restlessness of frequently approaching dogs, but we didn't find a relation between duration of locomotion (walking, trotting, running) and Delta CORT. The correlations between dog vocalizing and approaching behaviour and Delta CORT as well as the perception of the dogs' stress levels by their owners seem rather striking as these dog behaviours might be considered as attachment behaviour in order to seek and maintain contact to the owner while it should elicit caregiving behaviour of the attachment figure. Also in infants intensities of crying were significantly correlated with cortisol levels when being separated from the mother (Ahnert et al. 2004). These results might be another supportive contribution to the view that the dog-owner relationship may be described as an attachment bond.

In contrast to previous studies (Kerswell et al. 2009; Mariti et al. 2012) we found that owners consider more subtle behaviours as well, such as panting, snout licking and yawning. Interestingly, owners of dogs which were more frequently snout licking and yawning while being threatened by a strange person perceived their dogs as being less stressed than dogs which were less frequently snout licking and yawning.

Licking and yawning are discussed to play an important role in inter- and intraspecific communication of dogs which are stress- and anxiety-related behaviours (Feddersen-Petersen 2008; Pastore et al. 2011; Kuhne, Hößler and Struwe 2014). Yawning and snout licking might decrease the probability of agonistic behaviour in situations of potential conflict, because they might be read by a potential opponent as signs of ambivalence, making it unnecessary to escalate an agonistic situation; but this is hard to show (Wosegien and Lamprecht 1989). However, the relation of perceived lower stress level of the dogs and increased frequency of yawning and snout licking might be due to the by owners interpreted friendly character of these behaviours when being threatened, compared to for example growling and barking. Accepted indicators of stress of the dog mostly refer to body language, hunched posture or restlessness, panting, yawning or nose licking (Beerda et al. 1998). Interestingly none of these behaviours were related to the dogs' cortisol levels in our study which may indicate that our situations were not severe stressors. Ottenheimer Carrier (2013) found a hunched body posture related to high cortisol levels in a dog park. When left alone in a novel room none of the dogs of our study showed a body posture different than a neutral posture, whereas when being threatened by a human, only 29% of the dogs showed an insecure or submissive body posture. In the dog park dogs are interacting with many conspecifics, while lowered or impressing body postures seem to be a very meaningful social signal to conspecifics (Bonanni, Valsecchi and Natoli 2010). Therefore it seems very plausible that in our study we did not find such relations between body posture and cortisol modulation.

Generally the testing situations, the separation from the owner and the threat, did not elicit significant cortisol level increases in the dogs although our social challenges were rather uncontrollable (leashed during threat, locked in a room) and unpredictable. Interestingly, many dogs showed strong behavioural reactions in response to the challenges. It cannot be ruled out that our sample might be biased, as it needs a certain degree of engagement in the relationship to the dog when investing time and effort in participating in the study. Our sample might have consisted of above-average friendly and emotionally balanced dyads. Previously conducted mild challenges also did not elicit significant cortisol level increases (Schöberl et al. 2012).

We already mentioned that owners are well able to perceive their dogs' arousal behaviour by rating their stress levels higher when showing more arousal behaviour than when showing less arousal behaviour. However, we found that owners who felt very stressed during the testing situations rated their dogs as very stressed as well, although we could not find a correlation between the owners' own perceived stress levels and their dogs' arousal behaviour. Because of these findings, we suggest that owners judge their dogs by one's own mental state rather than feeling the same way as the dog when observing it. During the testing situations the owners' own mental states depend, amongst other things, on his/her perception of a situation; this perception may be based on his/her personality and his/her relationship to the dog. Hence, it might not be too remarkable that not only the dogs' behaviour influenced the owners judging their dogs stress level, but that an important component of this judgement is the owners´ own attitude.

Our results suggest that owner gender, age, personality and relationship to the dog influence the owners' perception of their dogs' mental state. Except for owner age, neither of these factors could be related to the dogs' actual arousal behaviour during separation and threat. Therefore, we conclude that how people see their dogs is determined by an individual mix of the dogs' behaviour, owner age and gender, owner personality and relationship to the dog. Except for dog behaviour these are subjective factors which may affect the perception differently according to the situational context. In our experimental tests the unpleasant character of the situations might be due to novelty of the test room, the separation from the owner and the social threat in the owner's presence. In both situations, women were more likely to consider their dogs as being stressed, which may be due to women being more empathetic and having more positive feelings towards animals in general (Mestre et al 2009; Ellingsen et al. 2010; O'Brien 2013). Actually dogs of male owners behaved differently during separation by panting more and showing much locomotion (walking, trotting, running), which might be considered as higher restlessness. Our findings concerning owner personality fit the theoretical background (Borkenau and Ostendorf 2008). Owners high on the agreeableness scale (Neo-FFI dimension 4) are considering their dogs' stress level higher in both testing situations (tendency for threat test) than owners low on the agreeableness scale. Agreeable persons are characterized by a general concern for social harmony

and others well-being and treat others with courtesy and sympathy. Owners, scaling high on extroversion (Neo-FFI dimension 2), perceive their dogs as being less stressed when being separated but not when being threatened. People high on extroversion may tend to rather feel comfortable in challenges like our experimental setting than people scoring low in extraversion. Therefore owners high in extraversion may feel less uneasy about being separated from their dogs than owners low in extraversion while the own mental state might be projected on the own dog. Owners high on the neuroticism scale (Neo-FFI dimension 1) perceive the threat test as less stressful for their dogs than owners low on the neuroticism scale. The own emotional instability might not be a good base for being interested or interpreting others' mental state or well-being. Owners who alienate themselves from their dogs (i.e. often are angry when being with their dog or do not feel accepted) perceived both situations, separation as well as threat, as more stressful for their dogs. Because of getting often angry with the dog, owners might have more negative feelings towards their dogs and might have a low degree of trust in their dogs to cope with the situation.

Marinelli et al. (2007) found that several owner characteristics influence the quality of life of the pet dog. Our question was which owners would put particular emphasis on the dogs' ability to handle stressful situations for the dogs' well-being. Contrary to our expectations, our results indicate that the owner-rated importance of a good stress management of the dog for its well-being is more related to owner personality, relationship to the dog and interaction style than to the dog's actual behavioural and physiological response to a potentially stressful situation. Though dogs of owners considering a good stress management as important stayed longer next to the door during separation and vocalized less when being threatened, these behaviours still could be rather expression of a different relationship of owner and dog. Hence, owners who highly emphasized a good stress management had higher scales on the secure/caregiving attachment style to their dogs and furthermore less frequently train their dogs with negative methods. Furthermore owners high on the neuroticism scale seem to be less concerned with the dog's mental state concerning potentially stressful situations.

To conclude, the higher the physiological stress responses of the dogs the more attachment behaviour the dogs showed and the higher the dogs stress levels were rated by their owners during the testing situations. An undisturbed chain of these three elements and an appropriate behavioural response of the owner might possibly be the most important parts of a well-functioning relationship between owners and their dogs. We found that owners are well able to interpret dog behaviour but still, the perception of their dogs is strongly influenced by owner-related aspects. Our results suggest that owners high on extraversion may be less sensitive to separation-related stressful situations of their dogs than owners high on extraversion, while owners high in neuroticism may be less sensitive to stressful situations with social conflicts than owners low in neuroticism. Possible limitations in the perception of the dogs' mental state may be compensated by the owners when being trained to interpret dog behaviour. The new insights in the owners' perception of their dogs might improve dog behaviour counsellors advising owners on dealing with problematic behaviour of their dogs. To implement our results into practice we recommend that extravert owners should be particularly trained to become more sensitive to separation-related situations while people high on the neuroticism scale should be trained to become more sensitive to situations with potential social conflicts for their dogs. Contrary to that, agreeable owners might sometimes burden themselves too much with concerns about their dogs' well-being. Furthermore, we suggest that owners should be particularly sensitive to the dogs' contact seeking behaviour and should assure them closeness if desired during a stressful situation. In good working relationships dogs are able to accept their owners as safe heaven (Gásci et al. 2013) which means for owners that they have a responsibility to improve their dogs emotional state when feeling very unwell, for example when being threatened. When being aroused, the probability that dogs show undesirable behaviour is increased. To establish a good relationship with their dogs, it might be of great importance for owners to help their dogs to cope with the stressful situation rather than punish them for undesirable behaviour, besides that it is suggested that punishment might not be very effective in improving dog behaviour compared to positive training methods (Hiby, Rooney and Bradshaw 2004).

Several studies suggest that questionnaires might be useful for screening dog behaviour and behaviour problems (Hsu and Serpell 2003; McGreevy and Masters

2008; Kubinyi, Turcsán and Miklósi 2009). By aid of questionnaires data of a large sample can be collected effectively. But still, behaviour and characteristics are reported by owners, being more or less engaged in the relationship to the dog. Hence, according to our results we conclude that by the assessment of dog behaviour and dog personality by questionnaires only, owner-related aspects might highly be reflected. It is important to combine questionnaire studies and experimental studies to further investigate the owners' subjective perception.

7. Acknowledgement

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Curriculum Vitae

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2011 – until now	**University of Vienna** “Behavior, Neurobiology and Cognition”, Master Programme
2011 – 2012	**University of Veterinary Medicine Vienna** “Veterinary Medicine”, Diploma Programme
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School Education

2003 – 2007	**Secondary school in Perg**, General qualification for university entrance
2002 – 2003	**Higher Technical Institute in Waidhofen/Ybbs**
1998 – 2002	**Secondary school in Ardagger**
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Congress Contributions

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Linz, 31.05.2015

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