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A pilot study on the qualitative assessment of the impact of human-canine relationships on dogs' susceptibility to stress

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Abstract: The aim of the study was to determine the impact of canine-human relationship on dogs' susceptibility to stress during tests that evaluate a dog's suitability for canine-assisted therapy. Twenty-four dogs and their owners were included in the study. Dogs from all groups were most likely to manifest stress by nervous tail wagging/hugging, which could suggest that tail movements and the position of the tail are the key markers of emotional states in dogs. An analysis of pooled results revealed that dog-owner relationships influenced the animals' susceptibility to stress. These findings indicate that human-canine bonding plays an important role in dog behaviors. In this study, stress levels were higher in dogs that were less bonded with their owners. Apparently, dogs that have good contact with humans are better equipped to cope with stress than animals which are less reliant on their owners.

Key Words: human-canine relationship, stress in dogs, therapy dogs, dog behavior, calming signals.

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Introduction

Therapy dogs are exposed to numerous stress factors. Their owners should be able to read the common signs and symptoms of stress manifested by dogs. Dogs should be closely monitored, and their working time and work difficulty should be modified accordingly. Similarly to Germany and Norway, Poland does not have legal regulations concerning dogs for canine-assisted therapy (Wohlfarth & Sandstedt, 2016). Consequently, an official examination system for therapy dogs does not exist. Canine-assisted therapy is provided mostly by non-profit organizations, most of which evaluate the animals. Some organizations subject therapy dogs to preliminary tests to ensure that they are fit for the job. These tests aim to determine whether the dog copes well with stress, and whether it should undergo professional training. In addition to evaluating the dog's behavior, these tests also provide ample information about the animal's relationship with humans. Dogs need to bond with their owners to perform their tasks well, and the established relationship has to be based on trust and a sense of security (Serpell, 2017). The way dogs are trained, the tone of the human voice, human attitudes, and the demands placed on dogs affect each party in the relationship. In positive training, dogs will be more eager to cooperate, they will feel relaxed and more willing to trust their owners when their guardians use a gentle tone of voice, have balanced requirements and adopt a strong, but not overtly strict attitude. Coercion and physical punishment may cause dogs to withdraw and fear the handler (Sjösten, 2006; Owens & Eckroate, 2007).

Dogs communicate with each other and with other animals, including humans, based on olfactory, visual, acoustic and tactile signals which are mutually interconnected. Dogs manifest joy, peace, but also fear. The owners should closely observe their dogs in order to correctly interpret their companions' intentions. Experienced dog owners know when to intervene and break the

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tide of anxiety to prevent the dog from attacking a third party in a self-defense (Wilde, 2006).

It is believed that a dog's behavior reflects the owner's emotional state. In other words, dogs are relaxed when their owners feel peaceful, whereas anxious owners will stir the same emotions in their animals. The owner's erratic behavior (punishing or rewarding the dog for the same behavior) can also be a source of stress for a dog.

The impact of human emotions and attitudes on canine behavior has been widely discussed in cynological literature (Sjösten, 2006; Donaldson, 2007; Owens & Eckroate, 2007; Rugaas 1997). However, to the best of our knowledge, the impact of canine-human relationships on the incidence of stress responses in dogs has never been investigated experimentally. In view of the above, the aim of this study was to determine the impact of canine-human relationship on dogs' susceptibility to stress during tests that evaluate a dog's suitability for canine-assisted therapy.

Materials and methods

Twenty-four dogs and their owners were included in the study. The animals were purebred and mixed breed male and female dogs of different age and origin. The dogs' suitability for canine-assisted therapy was assessed by an experienced trainer, referred to as the test leader (TL). Fifteen assistants also took part in the test. The test was performed in a closed room measuring 10 x 15 m, with a ceramic tile floor and large windows. The test consisted of nine subtests (stages):

1. The owner walks a leashed dog diagonally across the room from the entrance door.The assistants stand still at various points in the room.
2. The owner walks a leashed dog back to the entrance door. The assistants walk around the room.
3. The owner walks a leashed dog diagonally across the room from the door. The assistants walk around the room, and approximately every second, one of the assistants hits the floor loudly with a stick.
4. The dog is unleashed, the owner remains neutral, and the assistants stand still at various points in the room.
5. The owner calls the dog and puts it on the leash. The assistants stand still at various points in the room.
6. The owner gives the dog a "sit down" command. The assistants stand still at various points in the room.
7. The TL crouches and touches the dog's sides, back, fore and hind paws, and head.
8. The TL stands approximately 2 m in front of the dog, squeezes a squeaking toy, and drops it before the dog. The assistants stand still at various points in the room.
9. The TL throws a hard object which lands approximately 1 m behind the dog with a loud a noise; the assistants stand still at various points in the room.

The entire test was recorded with a video camera, and the video footage was evaluated independently by two canine behavior experts (COAPE certified animal behaviorists). The first expert assessed the quality of dog-owner relationships based on observations of eye contact between the dog and the owner, and the dog's compliance with the recall command. The observations were graded on the following scale: good (group I), average (group II) and poor (group III). Each group consisted of eight dogs. The second expert assessed the severity of stress responses in dogs based on the animals' general behavior and stress response indicators such as nervous tail wagging/hugging, pulling and jerking on the leash, sniffing the ground, fur shaking, and licking (Table 1). These observations were graded a scale of 0 to 5 points, where 0 denoted the lowest and 5 – the highest stress response.

Table 1. Dog's stress response indicators analyzed in the study.

Behavior	Description
Nervous tail wagging/hugging	The dog slowly wags its tail which is held much lower than its natural position or tucks it under the body
Pulling and jerking on the leash	The dog pulls/jerks the leash to move away from the stressor
Sniffing the ground	The dog sniffs the ground (for less than 2 seconds*)
Fur shaking	The dog slightly shakes off or involve the entire body as if it was wet
Licking	The dog licks the nose or the lips

*adapted from Mariti et al., 2017

The results were expressed as means ± standard error of the mean (SEM). The data were processed statistically using the Kruskal-Wallis test, and the significance of differences between groups was verified by Nemenyi's post-hoc test. The stress response of every animal was presented separately for each stage of the test to illustrate the diversity of canine behaviors. The results were then pooled and used in the calculations together with external variables. All calculations were performed in R software (R Core Team, 2015).

Results

Group I dogs (that made good eye contact with their owners) where characterized by a lower stress response to the auditory stimulus in stage 3 of the test than group III dogs (poor eye contact) (Table 2). The stress responses to the auditory stimulus in stage 9 of the test (object thrown behind the dog) was higher in group II dogs (average eye contact) (3.00) than in group III animals (0.50). Surprisingly, the stress responses of group III dogs were moderate (2.00) in the above procedure. In general, group I dogs were less susceptible to auditory and tactile stimuli than group II and group III animals (0.43 vs. 1.84 and 2.00, respectively).

Table 2. Associations between dog-owner eye contact and stress responses to auditory and tactile stimuli (mean ± SEM, n=8).

Stress response to	Dog-owner eye contact			*P-value*
	Group I (good)	Group II (average)	Group III (poor)	
Auditory stimulus (stage 3)	0.00 ± 0.00^{B}	1.25±0.53	2.38 ± 0.60^{A}	*0.001*
Tactile stimulus (stage 7)	0.88±0.48	1.50±0.63	2.38±0.53	*0.099*
Auditory stimulus (stage 8)	0.38±0.38	1.50±0.63	2.38±0.53	*0.219*
Auditory stimulus (stage 9)	0.50 ± 0.38^{b}	3.00 ± 0.82^{a}	2.00±0.73	*0.048*
Total for stages 3, 7, 8, 9	0.43 ± 0.19^{b}	1.84 ± 0.39^{a}	2.00 ± 0.48^{a}	*0.007*

Means within a row followed by a different superscript differ significantly, where lower-case superscripts differ at $P<0.05$, and upper-case superscripts differ at $P<0.01$.

The above results corroborate the observations concerning dog-owner relationships and stress responses to auditory and tactile stimuli (Table 3). Dogs with strong bonds to their owners (group I) were less stressed in response to auditory stimuli in stages 3, 8 and 9. Similarly to previous test

stages, no significant differences were noted in the dogs' responses to tactile stimuli. In general, group I animals were less susceptible to stress than group II and group III dogs (0.34 vs. 1.72 and 2.21, respectively).

Table 3. Associations between dogs' general relationship with their owners and stress responses to auditory and tactile stimuli (mean ± SEM, n=8).

Stress response to	Dog's general relationship with owner			*P-value*
	Group I (good)	Group II (average)	Group III (poor)	
Auditory stimulus (stage 3)	0.00±0.00^{B}	1.13±0.44	2.50±0.63^{A}	*0.001*
Tactile stimulus (stage 7)	0.88±0.48	1.38±0.38	2.50±0.71	*0.139*
Auditory stimulus (stage 8)	0.00±0.00^{b}	2.00±0.80	1.25±0.53^{a}	*0.039*
Auditory stimulus (stage 9)	0.50±0.38^{b}	2.38±0.84	2.63±0.75^{a}	*0.050*
Total	0.34±0.13^{Bb}	1.72±0.40^{a}	2.21±0.44^{A}	*0.001*

Means within a row followed by a different superscript differ significantly, where lower-case superscripts differ at P<0.05, and upper-case superscripts differ at P<0.01.

The stress response indicators determined during the test and the associations with dog-owner eye contact are presented in Table 4. No significant differences between groups were observed in an analysis of single traits, but nervous tail wagging/ hugging and pulling and jerking on the leash appeared to increase with worsening eye contact between the dog and its owner (P=0.064 and P=0.077, respectively). In general, group I dogs were characterized by lower stress indicator values than group III animals (0.55 vs. 1.13).

Table 4. Associations between dog-owner eye contact and stress response indicators during the test (mean ± SEM, n=8).

Stress response indicator	Dog's eye contact with their owner			*P-value*
	Group I (good)	Group II (average)	Group III (poor)	
Nervous tail wagging/hugging	0.88±0.44	1.63±0.56	2.75±0.56	*0.064*
Jerking on the leash	0.38±0.38	0.50±0.27	1.25±0.37	*0.077*
Sniffing	0.63±0.26	0.25±0.16	0.38±0.18	*0.516*
Fur shaking	0.50±0.19	0.50±0.19	0.38±0.18	*0.851*
Licking	0.38±0.18	0.88±0.35	0.88±0.52	*0.658*
Total	0.55±0.20^{b}	0.75±0.17	1.13±0.11^{a}	*0.033*

Means within a row followed by a different lower-case superscript differ significantly at P<0.05

As shown in Table 5, stress levels were lower in dogs that complied with the recall command (group I) than in the least obedient animals (group III) (0.38 vs. 1.20). In particular, nervous tail

wagging/hugging was determined at 0.63 in group I and 3.13 in group III. Certain differences, although statistically not significant (P=0.077), were also noted in pulling and jerking on the leash. This indicator was determined at 0.13 in group I, 0.75 in group II and 1.25 in group III.

Table 5. Associations between compliance with the recall command and stress response indicators during the test (mean ± SEM, n=8).

Stress response indicator	Compliance with the recall command			*P-value*
	Group I (good)	Group II (average)	Group III (poor)	
Nervous tail wagging/hugging	0.63±0.42^{B}	1.50±0.50	3.13±0.44^{A}	*0.006*
Jerking on the leash	0.13±0.13	0.75±0.37	1.25±0.41	*0.077*
Sniffing	0.50±0.27	0.50±0.27	0.25±0.16	*0.617*
Fur shaking	0.25±0.16	0.75±0.16	0.38±0.18	*0.124*
Licking	0.38±0.18	0.75±0.31	1.00±0.53	*0.727*
Total	0.38±0.12^{B}	0.85±0.16	1.20±0.12^{A}	*0.003*

Means within a row followed by a different upper-case superscript differ significantly at P<0.01.

The associations between dog-owner relationships and stress response indicators in dogs during the entire test are presented in Table 6. Stress levels manifested by nervous tail wagging/hugging (0.58 in group I vs. 1.10 in group III) were influenced by the strength of dog-owner relationships. The difference between group I and group III was close to being statistically significant (P=0.056).

Table 6. Associations between the general dog-owner relationship and stress response indicators during the test (mean ± SEM, n=8).

Stress response indicator	General dog-owner relationship			*P-value*
	Group I (good)	Group II (medium)	Group III (poor)	
Nervous tail wagging/hugging	0.75±0.41^{b}	1.75±0.62	2.75±0.49^{a}	*0.039*
Jerking on the leash	0.50±0.38	0.50±0.27	1.13±0.40	*0.306*
Sniffing	0.75±0.25	0.13±0.13	0.38±0.18	*0.109*
Fur shaking	0.50±0.19	0.50±0.19	0.38±0.18	*0.851*
Licking	0.38±0.18	0.88±0.35	0.88±0.52	*0.658*
Total	0.58±0.20	0.75±0.18	1.10±0.11	*0.056*

Means within a row followed by a different lower-case superscript differ significantly at P<0.05.

Discussion

So far, studies have been conducted on the bond between a dog and his owner (reviewed by Payne et al., 2015) or a dog and all human members of his family (Carlone et al., 2019). On the other hand, various stress-related signals in dogs were analyzed (Firnkes et al., 2017; Mariti et al., 2017). The novelty of the current study is that it analyzes the impact of the relationship between a dog and his owner on dogs' susceptibility to stress. The results contribute to a better understanding of this matter and can help to improve welfare of dogs. They confirm the common view among cynologists that the dog's bond with his owner is of great importance for the former. However, only a qualitative analysis was carried out and no inter-rater reliability assessment was made, therefore the results should be seen as preliminary.

Owners can tell when their dogs experience discomfort or fear by observing their body language (Firnkes et al., 2017). Dogs often communicate stress through calming signals to avoid a certain stimulus or to change the behavior of another animal (Rugaas, 1997). Dogs generally use many signals at the same time, and some signals are ambiguous. Innate behaviors, such as scratching the ground with fore paws, vocalization, hair licking, panting, tail wagging, urinating, running around in circles, and rapid body movements, can also act as calming signals (Pastore et al., 2011). All dog behaviors in response to auditory and tactile stimuli were evaluated in this study (Tables 2 and 3), and the examined stress indicators were nervous tail wagging/hugging, pulling and jerking on the leash, short sniffing, shake off behavior, and licking (Tables 4, 5 and 6). Dogs from all groups were most likely to manifest stress by nervous tail wagging/hugging, which could suggest that tail movements and the position of the tail are the key markers of emotional states in dogs. An analysis of pooled results revealed that dog-owner relationships influenced the animals' susceptibility to stress. These findings indicate that human-canine bonding plays an important role in dog behaviors.

Deficient socialization is one of the key causes of anxiety and susceptibility to stress in dogs (Wilsson, 2016). Dogs that become familiar with various auditory and tactile stimuli at an early age are more resistant to stress and respond to it in a less agitated manner in adulthood (Dietz et al., 2018). Anxious behavior can also be modulated by training to increase the dog's confidence in the owner and to strengthen human-canine bonds (Protopopova et al., 2012). A dog's willingness to obey the recall command is a good measure of success in basic training. According to Dennison (2007), dogs do not come when called if they are weakly or inadequately bonded with their owners, and the owners' behavior (attitude or tone of voice) can in itself be a source of stress for dogs. A dog that trusts its owner and has bonded with its owner will be always ready to obey the recall command. Owens & Eckroate (2007) have argued that at least 50% of dog behaviors are related to the owner's emotional state. However, the above claim was not backed by experimental results. In the present study, group I dogs (which scored high in the obedience test) were less stressed during the test than group III animals (which scored lowest in the obedience test) (Table 5). The frequency and duration of eye contact between the dog and the owner is also a robust indicator of human-canine bonding. Dogs that maintained good eye contact were also less stressed during the evaluation than animals that had poor eye contact with their owners (Tables 2 and 4).

The expert assessment was conducted on the assumption (adapted from Mariti et al., 2017) that short sniffing (up to 2 seconds) is a calming signal. Sniffing is one of the favorite dog activities. Sniffing is a form of canine cognition, but it can also manifest stress. Sniffing can be an innate behavior that enhances a dog's olfactory perception, but dogs also sniff to modify the behavior of other animals, for example, to calm down an aggressive dog or to make contact with a shy dog. In this study, dogs that were well bonded with their owners and were generally less stressed, were also somewhat more likely to engage in short sniffing behavior than the animals from the remaining groups (Tables 4, 5 and 6). Sniffing could also be a way to establish dialogue with the humans present in the test room. Interestingly, group I dogs were also more likely to engage in prolonged sniffing that the remaining animals (data not shown in tables).

Dogs rarely engage in "shake off" behavior when they feel relaxed, but this bodily movement is frequently observed in stressful situations. Fur shaking is often taken into consideration in analyses of stress-dependent parameters (Pastore et al., 2011). Dogs shake their fur to alleviate stress and return to a positive emotional state. This behavior is frequently observed in dogs characterized by high levels of general self-satisfaction, including many terriers. For this reason, dogs that shake their fur under similar stress conditions are not always more stressed.

In this study, stress levels were higher in dogs that were less bonded with their owners. Apparently, dogs that have good contact with humans are better equipped to cope with stress than animals which are less reliant on their owners.

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Uno studio pilota sulla valutazione qualitative dell'impatto della relazione uomo-cane sulla suscettibilità allo stress

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Sintesi

Lo scopo dello studio è stato quello di determinare l'impatto della relazione uomo-cane sulla suscettibilità del cane allo stress, durante test che valutano l'adeguatezza del cane per essere utilizzato in Interventi assistititi.

Nel presente studio sono stati inclusi 24 animali ed i loro proprietari. L'analisi dei risultati ha dimostrato che la relazione uomo-cane influenza la suscettibilità dell'animale allo stress, indicando che il legame con il proprietario esercita una influenza importante sul comportamento del cane. I livelli di stress più alti sono stati trovati in cani meno legati al loro proprietario. Apparentemente i cani che hanno una buona relazione con le persone sono meglio equipaggiati a fronteggiare lo stress, rispetto ad animali meno legati ai loro proprietari.