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Dog behavior in the Ainsworth Strange Situation Test during separation from the owner and from the cohabitant dog

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Abstract: Dogs are known to form strong relationships towards subjects of their own kind and of other species. The aim of this research was to compare dog behavior when separated from a human and a canine companion. Sixteen dogs (9 females and 7 males, 49.8 ± 54.3 month old, belonging to different breeds) were observed during the 2-minute isolation episode of the Ainsworth Strange Situation Test. Each dog was tested twice: once the dog was separated from the owner and once from a cohabitant dog. The duration of 19 behaviors was measured in both conditions and compared using the Mann-Whitney test ($p<0.05$).

Proximity to the door (medians: 95.5 versus 54.5; $Z=2.38$; $p=0.017$), behaviors against the door (7.0 versus 0.0; $Z=2.13$; $p=0.033$), barking (0.0 versus 0.0; $Z=2.37$; $p=0.017$), and trying to escape from the experimental room (0.0 versus 0.0; $Z=1.83$; $p=0.067$) were statistically higher when dogs were separated from the conspecific compared to when separated from the owner; whilst passive behavior was higher when isolated from the owner (13.0 versus 0.0; $Z=3.18$; $p=0.001$).

Results suggest that dogs showed a higher protest at separation when isolated from a cohabitant dog. Although it may be interpreted as a display of a higher intraspecific attachment, the higher stress may be due to the separation from the conspecific summed to a condition where the owner was not present. It is possible that multi-household dogs have less opportunities to be left alone and therefore to get used to isolation. Thus, it may have important consequences on dog welfare.

Key Words: dog; attachment; behavior; Ainsworth strange situation test; stress; separation.

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Introduction

Canis familiaris is a highly social species (Tuber et al., 1996) and its social behaviors start at birth, becoming more complex as the puppy gets older (Beaver, 2009). As the ecological niche of domestic dogs is the human social environment (Kubinyi et al., 2007), a variety of studies concerning dog behavior in relation to humans were developed.

In the 1950's John Bowlby (1988), starting from psychoanalytic concepts (Harlow, 1958) and ethology (Lorenz, 1961), elaborated a theory of attachment that was valid for all mammals. Attachment bonds, defined as an affectional tie enduring over time, is formed by one person or animal between himself and another specific one (Ainsworth & Bell, 1970).

Relevant characteristics of this bond are: contact maintenance effect, that leads the subject to maintain physical contact and proximity with the attachment figure; searching response (which is also called protest at separation and separation anxiety, the latter not to be confused with the canine behavioral disorder), when far from the attachment figure and secure base effect, i.e. the attachment figure represents a base from which to explore the world (Ainsworth, 1969; Bowlby, 1988).

The behavioral test commonly used to study child attachment to the mother is called Ainsworth's strange situation test (ASST; Ainsworth & Bell, 1970). This test is built in order to mildly stress chil-

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dren, through the separation from the mother, in an unfamiliar environment, and therefore activating the attachment system. The observation of the child behavior when alone, with the mother and with a stranger allows psychologists to understand the kind of attachment that the child has towards the mother. The same test, suitably adapted, has been used by many authors to test dog attachment to man (Topál et al., 1998; Prato-Previde et al., 2003; Fallani et al., 2006; Palmer & Custance, 2008; Mariti et al., 2013a, 2013b) and only rarely to test intraspecific attachment in dogs, in puppies by Prato-Previde et al. (2009) and in adult dogs (Mariti et al., 2014; Mariti et al., 2017).

The aim of the current study was to compare the effect of separation from a human and a canine companion on the behavior of adult domestic dogs.

Materials and methods

Sixteen dogs, of both sexes (7 males and 9 females), of different age (49.8±54.3 month old) and breed, were studied. The inclusion criteria were: being more than 14 months old, having lived with the other dog and the owner for at least 9 months, being used to a wide variety of different environments and people (i.e. not being fearful nor aggressive to strangers, for safety reasons). Separation related problems of dogs acting as the attachment figure were excluded throughout a behavioral consultation performed by a veterinary behaviorist.

Dog behavior was analyzed in two modified versions of the Ainsworth strange situation test. In detail, each dog was tested twice, once for intraspecific attachment and once for interspecific attachment. The stranger was played by a young woman unfamiliar to the dogs. For the intraspecific test the presumed attachment figure was played by another dog living in the same household, whilst for the interspecific test, the presumed attachment figure was played by the owner. To avoid a possible order effect, half of the dogs underwent the intraspecific test first, and the other half underwent the interspecific test first. The 2 tests were separated at least 35 days one from the other.

As described in the Ainsworth strange situation, tests were carried out in an isolated room that was unfamiliar to the dogs. The tests were recorded by two video cameras, one oriented to the whole room and the other to the door.

Table 1. The seven episodes of Ainsworth strange situation. In bold the episodes analyzed in the present study.

EPISODES	**DESCRIPTION**	
1	DOG 1 + DOG 2 free in the room	DOG 1 + OWNER
	A strange person enters the room	
2	DOG 1 + DOG 2 + STRANGER.	DOG 1 + OWNER+ STRANGER
	The stranger goes to the chair and can greet the dogs, then she has to ignore them	
	Dog 2 leaves the room	The owner leaves the room
3	**DOG 1 + STRANGER**	
	Dog 2 enters the room	The owner enters the room
4	**DOG 1 + DOG 2**	**DOG 1 + OWNER**
	Dog 2 leaves the room	The owner leaves the room
5	**DOG 1 ALONE** In case the dog is too stressed for more than 60 s, the stranger can enter	
	A strange person enters the room	
6	DOG 1 + STRANGER	
	The strange person leaves the room	
	Dog 2 enters the room	The owner enters the room
7	DOG 1 + DOG 2	DOG 1 + OWNER

The protocol followed the original one proposed by Ainsworth. The dogs were led into the experimental room and left free to move about. There are 7 episodes (Table 1), each lasting 2 minutes, in which the examined dog stayed in the room alternatively with the owner or with the other dog (called Dog 2), with the stranger, with both of them or alone.

The test has been structured by Ainsworth in this way in order to study the three main characteristics of attachment, that are: protest at separation, contact maintenance effect and secure base effect. As a matter of fact, an individual that is involuntarily separated from the attachment figure is emotionally distressed, and therefore he displays signs of protest and tries to regain proximity. In dogs these states are mainly represented by: staying close to the door, showing behaviors against the door and vocalizing.

For this study, the analysis was focused on episode 5, when dogs were alone, but also episodes 3 and 4 were examined. In tables 2 and 3, the analyzed behaviors are reported.

Table 2. Social behaviors analyzed in the Ainsworth strange situation test.

SOCIAL BEHAVIORS	REFERENCES
Attention seeking	Mariti et al., 2011; Ricci et al., 2010
Contact: **– primary** **– secondary**	Mariti et al., 2014
Proximity: **– primary** **– secondary**	Mariti et al., 2014
Following	Palestrini et al., 2005
Approach	Prato Previde et al., 2003.
Visual orientation	Modified by Prato Previde et al., 2003
Social exploration	Mariti et al., 2014

Table 3. Non social behaviors analyzed in the Ainsworth strange situation test.

NON SOCIAL BEHAVIORS	REFERENCES
Exploration	Topàl et al., 1998; Prato Previde et al., 2003
Locomotion	Modified by Prato Previde et al., 2003
Passive behavior	Modified by Prato Previde et al., 2003
Close to door	Modified by Topàl et al., 1998
Behavior against door	Prato Previde et al., 2003; Palestrini et al., 2005.
Visual orientation to door	Prato Previde et al., 2003; Palestrini et al., 2005.
Barking	Palestrini et al., 2010
Whining	Modified by Prato Previde et al., 2003

The social behaviors could be displayed towards the stranger, the owner or dog 2, while non-social behaviors could be signs of stress (behaviors against the door, whining) or of calm (exploration and passive behavior).

Behaviors were observed through a continuous sampling and they were not mutually exclusive, as dogs could stay close to the door, scratch at the dog and barking at the same time.

Data was analyzed using a Friedman and then a Wilcoxon test through the SPSS® software.

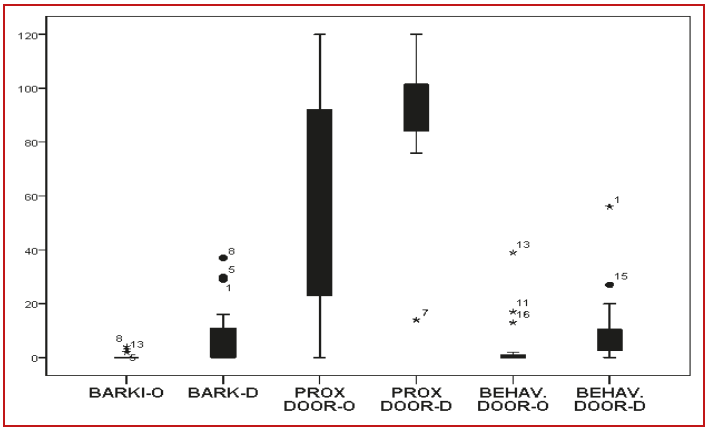
Differently from other studies using the ASST, the toys were not used, because their presence amongst dogs, especially when left alone, may have led to aggression.

The peculiarity of studying the intraspecific bond is that the attachment figure is played by

a dog and not by a person, so his/her behavior could not be standardized. For this reason, the stranger was helped by another person in managing the entrance and exit of Dog 2.

Results and discussion

The comparison of dogs' behavior in episode 5, when the animals were examined individually alone, provided many differences between being separated from the human companion and from the canine companion. Proximity to the door (Z=-2.38; p=0.017), behaviors against the door (Z=-2.13; p=0.033), barking (Z=-2.37; p=0.017), and trying to escape from the experimental room (Z=-1.83; p=0.067) were statistically higher when dogs were separated from the conspecific compared to when separated from the owner (Fig. 1).

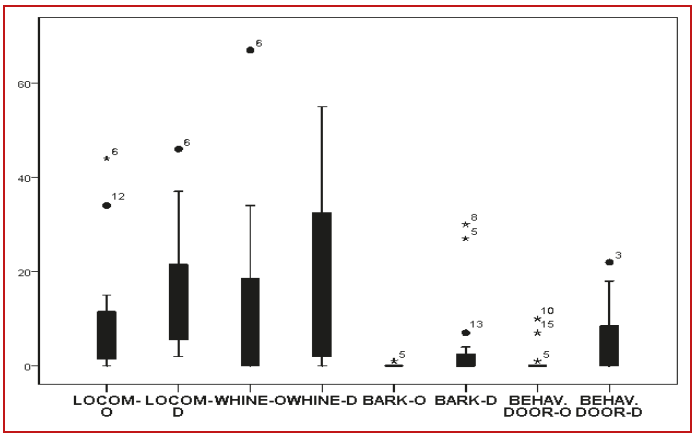


LEGENDA
Bark-O=Barking during owner absence.
Bark-D=Barking during other dog absence.
Prox Door–O=Close to door during owner absence.
Prox Door–D=Close to door during other dog absence.
Behav Door–O=Behavior against door during owner absence.
Behav Door–D=Behavior against door during other dog absence.

Figure 1. Dog behaviors in episode 5.

These results suggest that dogs showed a higher stress level when separated from a cohabitant dog than when they were separated from the owner. Althought this may be interpreted as a display of a higher intraspecific attachment compared to the interspecific attachment, other analyses are needed. In fact, to get a better understanding of these findings, dogs' behavior was analyzed in other two episodes of the Ainsworth strange situation test.

In episode 3 the dog was in the presence of the stranger, and the owner or the other dog had just left the room.

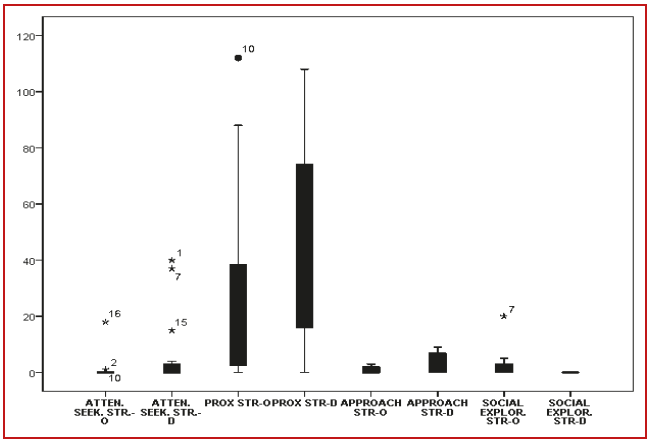


LEGENDA
Locom-O=Locomotion during owner absence.
Locom-D=Locomotion during other dog absence.
Whine–O=Whining during owner absence.
Whine–D=Whining during other dog absence.
Bark-O=Barking during owner absence.
Bark-D=Barking during other dog absence
Behav Door–O=Behavior against door during owner absence.
Behav Door–D=Behavior against door during other dog absence.

Figure 2. Dog behaviors in episode 3.

The dogs spent more time barking (Z=-2.023; p=0.043), whining (Z=-1.727; p=0.084), moving (Z=-2.303; p==0.021), and displaying behaviors against the door (Z=-2.395; p=0.017) when the cohabitant dog left rather than when the owner left: in other terms, the dogs showed more protest at separation in the absence of the other dog.

Social behaviors towards the stranger were, in general, higher after the dog left than the owner left, as shown in Fig. 3. Social exploration (Z=-2.68; p=0.007) and approach (Z=-2.392; p=0.017) resulted in fact statistically different.



LEGENDA

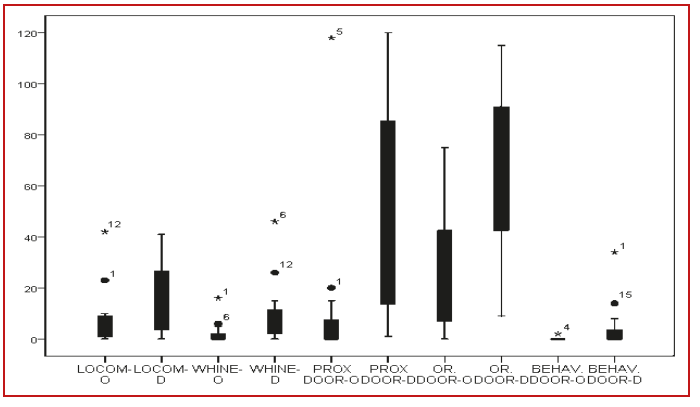
Atten Seek Str-O=Attention seeking from the strange person during owner absence.
Atten Seek Str-D=Attention seeking from the strange person during other dog absence.
Prox Str–O=Proximity to the strange person during owner absence.
Prox Str–D=Proximity to the strange person during other dog absence.
Approach Str-O=Approaching the strange person during owner absence.
Approach Str-D=Approaching the strange person during other dog absence
Social Explor–O=Social exploration of the strange person during owner absence.
Social Explor–D=Social exploration of the strange person during other dog absence.

Figure 3. Social behaviors towards the stranger in episode 3.

This can be interpreted as the need for dogs to seek comfort from the stranger, whilst passive behavior was higher when separated from the owner (13.0 versus 0.0; Z=3.18; p=0.001).

So, considering the findings of episode 3 together, dogs showed more stress when Dog 2 left than when the owner left and this confirms what the results of episode 5, when examined dogs were completely alone.

Concerning episode 4, when the owner or the other dog re-entered the room, if dogs were more attached to the other dog, they should reduce their stress and show affiliative behaviors in the presence of Dog 2 more than in the presence of the owner. Actually (Fig. 4), the dogs spent more time whining (Z=-2.485; p=0.013), oriented to the door (Z=-3.205; p=0.002), close to the door (Z=-2.845; p=0.004), and displaying behaviors against the door (Z=-2.207; p=0.027) when in company of the other dog than when in the company of the owner. Moreover, dogs displayed more social exploration towards the owner (Z=-2,374; p==0.018) than towards Dog 2.



LEGENDA

Locom-O=Locomotion during owner absence.
Locom-D=Locomotion during other dog absence.
Whine–O=Whining during owner absence.
Whine–D=Whining during other dog absence.
Prox Door–O=Close to door during owner absence.
Prox Door–D=Close to door during other dog absence.
Or Door-O=Visual orientation to the door during owner absence.
Or Door-D=Visual orientation to the door during other dog absence.
Behav Door–O=Behavior against door during owner absence.
Behav Door–D=Behavior against door during other dog absence.

Figure 4. Dog behaviors in episode 4.

Considering all the findings of episode 4 together, dogs showed more stress and less affiliation when the cohabitant dog was present than when the owner was present; this apparently contradicts previous results on the higher stress level at separation from the cohabitant dog.

In order to understand these controversial findings, the tests for intraspecific and interspecific attachment were separately analyzed and episode 5 was compared to episode 3 and 4 within the same test (Tab. 4).

Tab. 4. Comparison of behaviors among episodes 3, 4, and 5 in intraspecific and interspecific ASST.

BEHAVIOR	Episode 3 *vs* 5	Episode 4 *vs* 5	Episode 3 *vs* 4
INTRASPECIFIC ASST			
Behavior against the door	Z=-2.205 p=0.027	Z=-3.066 p=0.002	n.s.
Close to door	Z=-3.408 p=0.001	Z=-3.00 p=0.003	n.s.
Whining	n.s.	Z=-2.90 p=0.004	Z=-2.01 p=0.044
Barking	Z=-2.197 p=0.028	n.s.	n.s.
INTERSPECIFIC ASST			
Exploration	Z=-2.018 p=0.044	Z=-2.276 p=0.023	n.s.
Whining	n.s.	Z=-3.182 p=0.001	Z=-2.431 p=0.015
Close to door	n.s.	Z=-3.298 p=0.001	Z=-2.23 p=0.026
Visual orientation to the door	n.s.	Z=-3.465 p=0.001	Z=-3.181 p=0.001

Looking at the interspecific tests, the dogs, not surprisingly, displayed more signs of stress when left alone than in the presence of the owner and more signs of stress when in the presence of the stranger than in the presence of the owner and more social behaviors towards the owner than towards the stranger, as expected from previous studies on child-mother and dog-owner attachment. So there was a greater difference between staying with the owner on one hand and staying alone or with the stranger on the other hand, as expected for an attachment bond.

Considering the intraspecific tests, dogs showed more stress when left alone than in the presence of the other dog, but the difference between staying with the other dog or with the stranger was less pronounced. In this case there was a greater difference between staying alone on one hand and staying with the other dog or with the stranger on the other hand. In other words, for the interspecific test the relevant point was the owner, and for the intraspecific test the relevant point was being alone.

Conclusions

In conclusion, the results of the current study confirm what was previously found analyzing intraspecific attachment, that both a cohabitant dog (being the mother or not, respectively: Mariti et al., 2017 and Mariti et al., 2014) and an unfamiliar person have a strong ameliorative effect on the stress due to isolation. However, being separated from a canine companion is even more stressful

than being separated from a human companion in an unknown environment. The higher stress level displayed by dogs during the Ainsworth strange situation test for analyzing intraspecific attachment can be explained as being separated by the cohabitant dog summed to a condition where the owner is not present.

Further research is needed to better understand the attachment bond between adult dogs.

It is also possible that multi-household dogs have less opportunity to be left alone than single dogs, and therefore they are not used to isolation and this may have an important impact on dog welfare.

Generalization of these results should be done cautiously, due to the inclusion criteria of the sample used. However, this study seems to suggest that future research in this field may help the prevention and treatment of separation related problems, and also of problems related to the loss of a canine companion in dogs.

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Il comportamento del cane nell'Ainsworth Strange Situation Test durante la separazione dal proprietario e dal cane coabitante

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Sintesi

È noto che i cani sviluppano una forte relazione con soggetti della propria specie e di altre specie.

Lo scopo di questa ricerca è stato quello di confrontare il comportamento del cane separato dall'essere umano e dal cane convivente.

Sedici cani (9 femmine e 7 maschi, 49,8 ± 54,3 mesi di età, appartenenti a diverse razze) sono stati osservati durante l'isolamento di due minuti dell'Ainsworth Strange Situation Test.

Ogni cane è stato testato due volte: in un'occasione il cane era separato dal proprietario e in un'altra dal cane convivente. La durata di 19 comportamenti è stata misurata in entrambe le condizioni e confrontata usando il Mann-Whitney test ($p<0,05$).

La vicinanza alla porta (mediane: 95,5 versus 54,5; $Z=-2,38$; $p=0,017$), i comportamenti contro la porta (7,0 versus 0,0; $Z=-2,13$; $p=0,033$), abbaiare (0,0 versus 0,0; $Z=2,37$; $p=0,017$), e tentare di scappare dalla stanza sperimentale (0,0 versus 0,0; $Z=-1,83$; $p=0,067$) erano statisticamente più alte quando i cani erano separati dal cospecifico, in confronto a quando erano separati dal proprietario; i comportamenti passivi erano più alti quando i cani erano separati dal proprietario (13,0 versus 0,0; $Z=-3,18$; $p=0,001$).

I risultati suggeriscono che i cani mostrano una protesta più forte alla separazione quando sono isolati dal cane coabitante. Sebbene questo fatto possa essere interpretato come segno di un più forte attaccamento intraspecifico, l'elevato livello di stress può essere dovuto alla separazione dal cospecifico, sommato alla condizione dove il proprietario non era presente. È anche possibile che cani che vivano insieme a cospecifici abbiano meno opportunità di stare da soli e perciò siano meno abituati a restare in solitudine. Questo fatto può avere importanti conseguenze sul benessere del cane.

Problem solving games as a tool to increase the well-being in boarding kennel dogs

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Abstract: The kennel environment, even for short periods, is a potential psychogenic stressor for most dogs owing to its novel surroundings and separation from social attachment figures. To improve their well-being, they could be administered problem-solving games. This would benefit them because individual play, like problem solving, could improve an individual's physical and cognitive capabilities, and therefore their welfare.

The aim of this study was to evaluate how problem solving tasks improve welfare in boarding dogs.

The study was conducted in dogs from a boarding kennel in Lucca, Italy. The dogs were divided into two groups: the Problem Solving Group (PSG), formed by 6 bitches (3 neutered) and 9 males dogs (3 neutered), 32.0 ± 20.3 months old, who participated in problem solving sessions during the boarding period and the Control Group (CG), formed by 4 dogs (2 females and 2 males, 61.0 ± 48.0 months old), who did not attend such sessions. The survey was carried out using a purposely prepared questionnaire, distributed to the owners. when they left their dogs to a boarding kennel; the owners were asked to fill the same questionnaire two days after returning home, in order to evaluate the variation of the dogs' stress behaviors.

Statistical analysis shows that the PSG displayed decreased stress behaviors such as: follow the owner ($W = -2.831$; $P = 0.019$), scarf in coat ($W = -2.440$; $P = 0.041$) and excessive vocalizations ($W = -1.998$; $P = 0.061$), and in general a decrease in the high stress level. In CG the behaviors were observed: attachment (46.67%) and vocalizations (53.33%) and a general increase in the high stress level ($W=-2.236$; $p <0.025$).

In conclusion, this pilot study suggests that dogs, engaged in problem solving activities, appear to be less stressed after the housing in a boarding kennel dogs.

Key Words: Problem solving; boarding kennel; stress behaviors.

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Introduction

Stress can be defined as a threat to homeostasis of a living being (Moberg, 2000). The primary means that have been used to assess stress are physiological measures and behavioral observations (Bergamasco et al., 2010). Behavioral observations include lowered body posture, panting, vocalizing, paw-lifting, body shaking, and repetitive or stereotypic behaviors (Beerda et al., 2000, 1997; Hetts et al., 1992). To establish stress and subsequent welfare problems in dogs, behavioral parameters are of special interest because they may be measured easily and non-invasively (Beerda et al., 1997; 1998). The evaluation of behavioral responses is usually conducted by experts, mainly by administering specific stimuli to the dogs in experimental conditions (Beerda et al., 1998). Serpell & Hsu (2001) suggested that questionnaire methodologies have a potentially broad applicability for measuring dogs' behavior in situations where other conventional means are not easy to use, based on the fact that owners know their dogs' behavior better than anyone else. In fact, this method has been used in many other studies on dog behavior (Hiby et al., 2004; Rooney & Bradshaw, 2004; Marinelli et al., 2007; Gazzano et al., 2008a,b; Mariti et al., 2013), also when related to emotional state (Kerswell et al., 2009). Moreover, differences in stressor properties and

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in individual characteristics of dogs introduce variability in stress responses (Beerda et al., 1997; Rooney et al., 2009).

Given that with such a nonspecific response and variety of ways that an individual animal may try to cope (Koolhaas et al., 2011), it is not obvious how much agreement there should be between people when scoring stress. The advantage for an owner when assessing the level of stress in their dog is that they are very familiar with the dog's normal behavior, daily routine (Wojciechowska & Hewson, 2005) and more likely to see deviations (Lind et al., 2017). Besides, dog behavior varies significantly according to the time of day, and dogs behave very differently when people are present compared with when they are absent (Gaines et al., 2007).

The kennel environment, even for short periods, is a potential psychogenic stressor for most dogs owing to its novel surroundings and separation from social attachment figures. (Beerda et al., 2000; Hennessy et al., 2002; Pullen et al., 2010). To reduce the stress in this ambient, one growing area of research, pertaining to the welfare of kenneled dogs, is the idea of environmental enrichment. Environmental enrichment can be defined as any technique designed to improve the biological functioning of an animal through modifications of the environment (Newberry, 1995). The goals of environmental enrichment for kenneled animals was possibly stress reduction training programs to improve dogs' abilities to cope with stressful situations. (Beata et al., 2007).

Another problem for welfare of kenneled dogs is the separation from their familiar caregivers causing some dogs to experience distress (Overall, 1997). A possible stress reduction intervention for this problem could be cognitive activation through problem solving.

Problem solving can be defined as a subset of instrumental responses that appears when an animal cannot achieve a goal using a direct action (Shimabukuro et al., 2015). Therefore, the subject needs to perform a novel action or an innovative integration of available responses in order to solve the problem (Scheerer, 1963). This ability has been studied in dogs using a wide variety of tasks (e.g. Scott & Fuller, 1965; Frank & Frank, 1985; Miklósi et al., 2003; Osthaus et al., 2005). Individual play, like problem solving, could improve an individual's physical and cognitive capabilities, and therefore the welfare (Sommerville et al., 2017).

When problem-solving confidence was high, negative emotional intensity tended to reduce (Sugiura & Sugiura, 2015) and the dogs appear to be calmer and less fearful towards the strangers (Zilocchi & Carlone, 2016).

The aim of this study was to evaluate how the problem solving tasks improve welfare in boarding dogs.

Materials and methods

The study was performed on dogs in a boarding kennel in Lucca, Italy. The boarding kennel can host 20 dogs. The kennels were rectangular, concrete enclosures with a wire mesh front gate. The dogs were housed both singly and in pairs, according to the box's dimensions.

The sample included thirty dogs belonging to the following breeds: 9 mixed breeds, 4 Golden Retriever, 1 Labrador Retriever, 3 Maremmano Abruzzese, 2 Cocker Spaniel, 1 Chow Chow, 1 Cao de Agua Portugues, 1 Pitbull, 1 Beagle, 1 Cavalier King Charles Spaniel, 1 Weimaraner, 2 Jack Russel Terrier, 1 Kelpie and 1 Siberian Husky.

The dogs were divided into two groups: the Problem Solving Group (PSG), formed by 6 bitches (3 neutered) and 9 males dogs (3 neutered), 32.0 ± 20.3 months old, who participated to problem solving sessions during the boarding period and the Control Group (CG), formed by 4 dogs (2 females and 2 males, 61.0 ± 48.0 months old), who did not attend such sessions.

The problem solving tasks were conducted in an unfamiliar field near the boxes.

During each session, the tested dog and a male experimenter (always the same) were present. The experimenter was asked not to say or do anything during the sessions (Topál et al., 1997).

Several apparatus (described below) with three different levels of difficulty were used. A dog moved on the subsequent level when he/she had solved all the apparatus belonging to the previous level.

Each subject had to solve all the tasks of the first two levels of difficult and at least one problem solving games of the third levels. Each session lasted 20 minutes at most. The problem solving sessions were conducted once a day.

If the dog lost interest in the apparatus, the experimenter moved it or added more tasty food trying to increase dog's motivation. In case the dog was not interested in the apparatus despite the expedients described above and in order to end successfully the session, an easier apparatus (already solved by the dog) was provided to the dog.

The survey was carried out using a purposely prepared questionnaire. The owners of the two groups were given a questionnaire when they left their dogs to the boarding kennel and another questionnaire two days after returning home, to evaluate the variation of the dogs' stress behaviors.

The questionnaire was composed of 3 sections. The first addressed owners' personal data: sex, educational level (elementary/ middle school, high school, or university degree), and age (as suggested by Kubinyi et al., 2009: 18-30 years, 31-60 years and 60 years). The second section collected general information about the dog (such as sex, age, and breed) and experience with boarding kennels. The third section was focused on stress in dogs and consisted of 3 questions. A multiple-choice question aimed at understanding what owners intended by the term stress (see Results for the possible answers provided).

Table 1. List of surveyed behaviors as possible indicators of stress in dogs and relative scientific literature.

Behaviors	References
Urination and/or defecation	Beerda et al., 1998, 1999; Casey, 2002; Tod et al., 2005
Yawn	Beerda et al., 1998; Hennessy et al., 1998; Schildler & van der Borg, 2004; Dreschel & Granger, 2005; Tod et al., 2005; Rooney et al., 2007
Low activity	Beerda et al., 1997, 1999
High activity	Beerda et al., 1997, 1998; Casey, 2002; Rooney et al., 2007
Looking elsewhere	Rooney et al., 2009
Turning head	Schildler & van der Borg, 2004; Rooney et al., 2007
Crying (yelp, whining, whimper)	Schildler & van der Borg, 2004; Beerda et al., 1997; Rooney et al., 2007; Rooney et al., 2009
Hypersalivation	Beerda et al., 1997; Casey, 2002; Dreschel & Granger, 2005
Aggressiveness	Beerda et al., 1999; Casey, 2002; Schildler & van der Borg, 2004; Tod et al., 2005; Rooney et al., 2009
Trembles	Beerda et al., 1999; Dreschel & Granger, 2005; Tod et al., 2005; Rooney et al., 2009
Panting	Beerda et al., 1997, 1999; Hennessy et al., 1998; Casey, 2002; Schildler & van der Borg, 2004; Dreschel & Granger, 2005; Rooney et al., 2009
Nose licking	Beerda et al., 1997, 1998; Schildler & van der Borg, 2004; Tod et al., 2005; Rooney et al., 2007; Rooney et al., 2009
Paw lifting	Beerda et al., 1997, 1998, 1999; Schildler & van der Borg, 2004; Rooney et al., 2007; Rooney et al., 2009
Low appetite	Casey, 2002
Turning around/circling	Beerda et al., 1997, 1998, 1999; Casey, 2002; Schildler & van der Borg, 2004; Dreschel & Granger, 2005; Rooney et al., 2007
Excessive barking	Beerda et al., 1998; Schildler & van der Borg, 2004; Tod et al., 2005; Rooney et al., 2009
Eating and/or drinking much	Beerda et al., 1998; Tod et al., 2005
Autogrooming	Beerda et al., 1998, 1999; Rooney et al., 2007; Rooney et al., 2009
Other repetitive activities	Beerda et al., 1997, 1999; Rooney et al., 2009

Then, owners were asked to indicate which of the behaviors listed in Table 1 could indicate stress in dogs. The final question aimed at identifying the owners' opinion regarding the level of stress of their dogs: low (the dog is seldom stressed), medium (the dog is stressed only in specific situations), high (the dog is often stressed), or very high (the dog is always stressed).

Apparatus

1st LEVEL

A small polystyrene or plastic coffee cup, placed upside down over few pieces of food, was used as first solvable trial. Later the small cup was changed with a normal size glass first, and then with a more stiff and transparent cup almost 15 cm high.

Due to dogs' preference to use paws or muzzle to solve the trial, further apparatuses were proposed in different order. The apparatuses proposed were: 2 wicker baskets (15 cm and 23 cm diameter); a transparent plastic small cup (10 cm diameter), a pyramid formed by jar's tops between which were placed titbits of food.

2nd LEVEL

Rolled towel

A rolled cotton towel inside which food rewards were placed (Fig. 1).

The cage

A cotton towel was placed on a small wooden board on which a metal cage with two side opened was fixed. At both the open side of the cage the towel's ends were left outside to let dogs drag out the towel and eat the titbits of food that were placed on it (Fig. 2).

Fig. 1. The rolled towel.

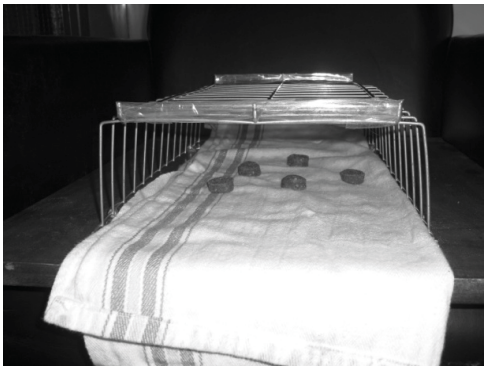

Fig. 2. The cage.

The "roulette"®

This apparatus had several compartments to fill with treats covered with a top disc. When the dog tried to get the treat from a compartment contacting the top disc, it turned and disclosed the following compartment. More information can be obtained from the Trixie instruction.

The twister

This apparatus was realized fixing three small rotating wooden boards on a wooden base. A jar top was fixed at the ends of each small wooden board. The small wooden boards were arranged in a parallel manner to hide the titbits of food placed in each jar top. The dog had to turn the small wooden boards to catch all the treats.

3rd LEVEL
Turn Around ®

This apparatus had a turning element with a lid. Some titbits of food were placed into the turning element and the dog must turn it to get the treats out. In order to reduce the noise, a lightweight bottle was used for more timorous and small size dogs.

More information can be obtained from the Trixie instruction.

Pull out the disk

This apparatus was realized using a plastic tube on which two fissures were produced at different heights.

A wooden disk was placed in one of these fissures to close the plastic tube. Tidbits of food were placed inside the tube and the dog had to pull out the disk from the plastic tube in order to drop the treat on the floor. In some cases, a towel were placed on the floor under the apparatus in order to reduce the fallen disk's noise. For more timorous dogs a lightweight plastic disk was used.

The strategy game Chess ®

Chess is a board game with cones and small indentations for hiding small treats for dogs to sniff out. More information can be obtained from the Trixie instruction.

All statistics were run with the software SPSS® Statistic 17.0 (Chicago, IL, USA).

Results

The population of owners in both groups was relatively balanced for sex (53.3% males and 46.67% females). Less than half the respondents had a university degree (40% PSG; 46.67% CG), 40% PSG and 26.67% CG had obtained a high school diploma and 20% PSG and 26.67% CG had a elementary/middle school diploma.

More than half of the CG respondents (60%) correctly considered that stress is a short- or long-term alteration of the psychophysical equilibrium of the animal that can develop into an illness, while in the PSG only 20%.

Figure 3 reports behaviors that the owners believed were possible indicators of stress in dogs. In the list of behaviors reported in Table 1, some behaviors were more subtle (i.e., yawning, looking elsewhere, turning head, nose licking, and paw lifting), but some respondents were able to identify at least 1 of the subtle behaviors as a possible indicator of stress.

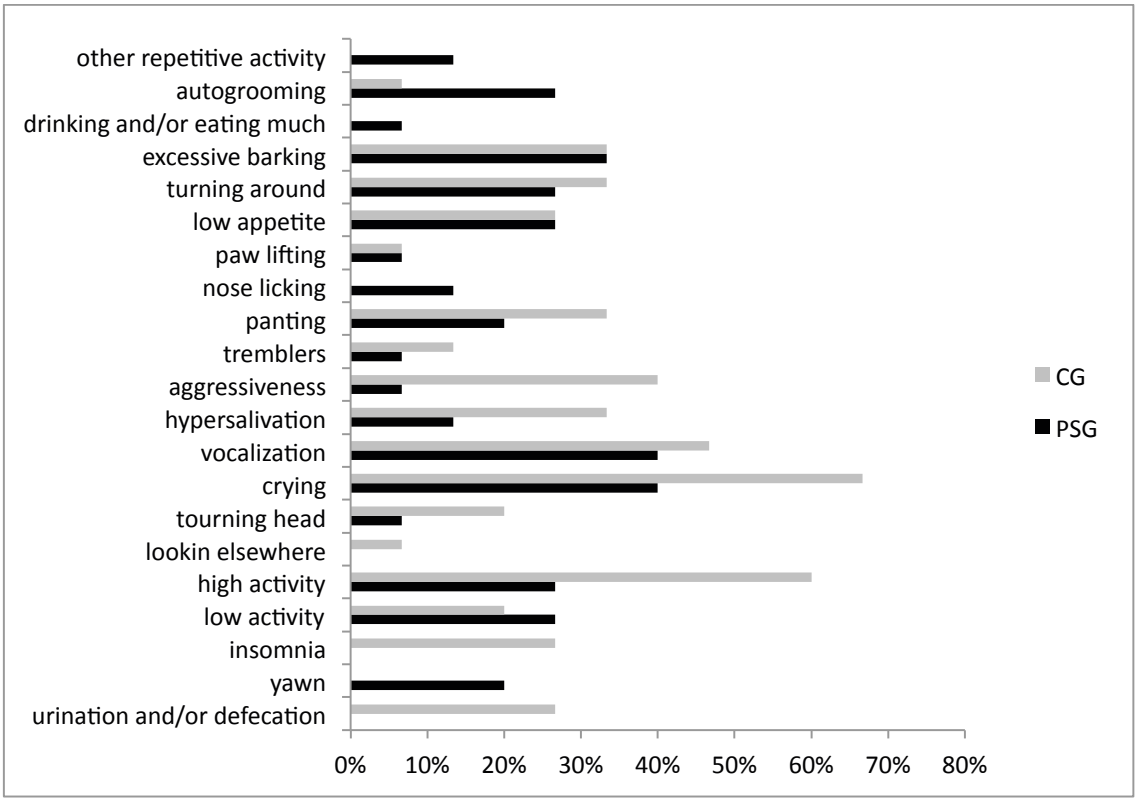

Fig. 3. Behaviors that were correctly identified as possible indicators of stress in dogs.

The other important question was if the dogs showed stress behaviors after returning home.

Answers to this question showed significant statistical differences between the two groups in some behaviors (Table 2).

Table 2. Stress behaviors in PSG and CG groups after the return home.

QUESTIONS	PSG	CG				
	MEDIAN	RANGE	MEDIAN	RANGE	W	p
Follow the owner	2.40	2.05-2.75	3.00	2.79-3.21	-2.831	0.019
Stools more solid	4.33	3.53-5.13	3.33	2.72-3.95	-2.261	0.056
Scarf in coat	4.13	3.11-5.16	5.60	5.02-6.18	-2.440	0.041
Excessive vocalizations	3.13	2.09-4.18	3.87	3.12-4.62	-1.998	0.061

In the PSG the dogs did not have high stress level, the medium stress level remained constant and there was an increase in the low stress level. Instead in the CG there was an increase in the number of dogs with high stress level, the medium stress level was unchanged and the low level reduced.

The statistical analysis, on the total scores relative the stress level before and after the permanence in the boarding kennel, revealed that in CG there was a significant increase ($W=-2.236$ $p<0.025$), while in PSG such trend was not found ($W=-1.732$, $p<0.083$).

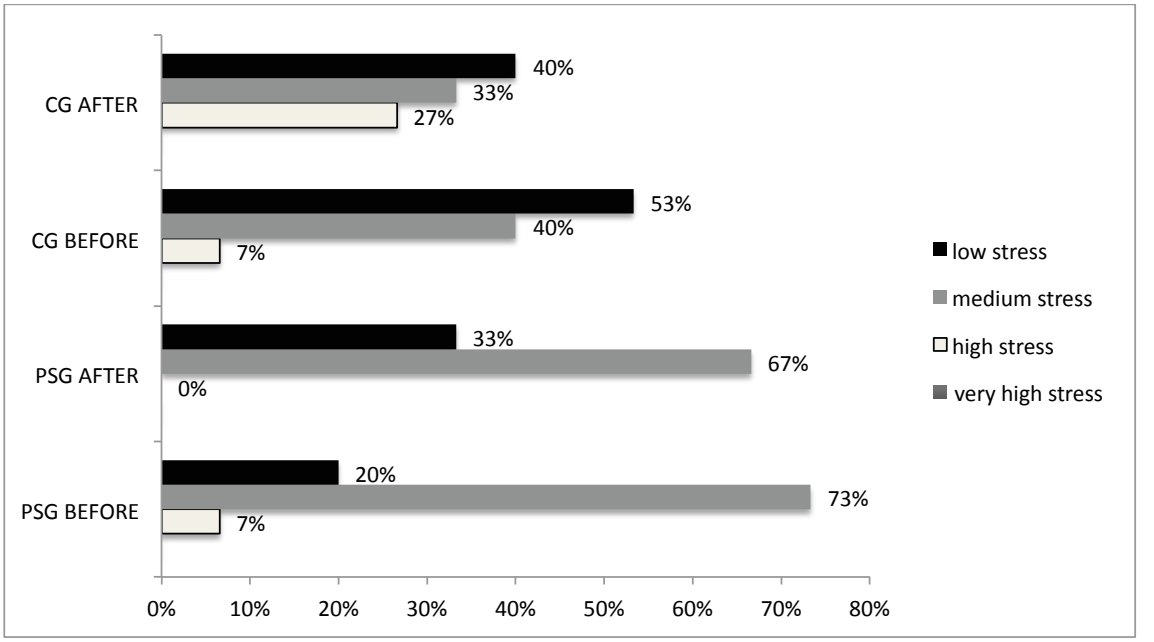

Fig. 4. Perception of stress levels in the two groups before and after the permanence in the boarding kennel.

Discussion

The aim of this study was to evaluate how problem solving trials on dogs improve welfare in boarding dogs.

Stress is a common experience in everyday life, as all living beings need to adapt to instabilities in their environment to ensure survival and reproductive fitness. A behavioral response is often the most efficient option to resolve the stressful situation, allowing the organism to regain homeostasis.

Behavior may also be the consequence of the rapid activation of the autonomic nervous system (piloerection, panting, and trembling) or is indicative of a state of stress that is by now chronic (e.g., stereotypies) (Moberg et al., 2000). Dogs show a range of behaviors that reflect their emotional state (Beaver, 1981; 1982). The ability of owners to recognize the behavioral signs of stress is important, as it permits the animal to avoid related welfare problems (Kerswell et al., 2009) and it favors a rapid recovery of psychophysical homeostasis by interrupting the progression to overstress and distress.

The inability of the owner to interpret and understand dog language should not be underestimated, as it prevents the owner from acting correctly when the animal is stressed and represents a potential cause of behavioral problems in the dog. (Voith et al., 1992; McBride et al., 1995; O'Farrell, 1995; Jagoe & Serpell, 1996).

Our sample was homogeneous as regards sex in both groups of owners; this is important because women have been reported, in some studies, to be more knowledgeable about, empathic, nurturing, and positive toward animals than males (Kellert & Berry, 1987), and male owners may be less able to recognize and interpret stress-related behaviors (Mariti et al., 2012).

In both groups most respondents had at least a high school diploma (PSG 80%, CG 73.74%) and of these 40% had a degree (PSG 40%, CG 46.47%).

Mariti's et al. (2012) found that the owners with a university degree or a high school diploma were better at correctly identifying the definition of stress. A higher educational level may help in

understanding what stress is and what it can lead to. High educational levels have been found to be predictive of knowledge of animal species.

Living in a shelter environment, even for short periods (Kogan et al., 2012), is a potential psychogenic stressor for most dogs. (Duranton et al., 2017). For this reason we proposed the problem solving tasks, because this should evoke an immediate positive emotional state in animals, as a means to motivate the dog to explore and solve problems, even if the true benefit of the behavior is in the long term. (Ragen et al., 2014). The idea that providing animals with opportunities for learning and problem-solving could elicit positive emotions has been the topic of discussion. (Meehan & Mench, 2007; Boissy et al., 2007; McGowan et al., 2010; Zilocchi & Carlone, 2016). In our study the PSG showed statistically fewer stress behaviors like: follow the owner (W=-2.831; P=0.019), scarf in coat (W=-2.440; P=0.041), excessive vocalizations (W=-1.998; P=0.061) than the other group, after the problem solving sessions during the housing in a boarding kennel. These behaviors may also represent learned attention-seeking strategies or the result of dermatological pathologies (Paterson, 2003), like scarf and all are potentially indicative of frustration (Webster, 1994).

Whereas the incidence of "stools more solid", well-being index, increased in the PSG over the housing periods.

The overall analysis of the responses on the stress signals in the two groups highlights how the dogs' owners in CG detect a higher increase in the level of stress of their dogs leaving the pension structure, compared to that observed by the experimental group.

This results could be related to problem solving sessions and suggest that they appeared less stressed than the control group.

Our results, in according with McGowan and coll. (2014) support the idea that opportunities to solve problems, make decisions, and exercise cognitive skills are important to an animal's emotional experiences and ultimately, its welfare. From an evolutionary standpoint, it makes sense that animals should react emotionally to their own achievements during problem-solving tasks as, to some degree, heightened states of emotion can facilitate learning and memory as long as they are not too intense (i.e., too much excitement or fear can interfere with the learning process). Positive affective feelings help animals to better identify behaviors that are biologically useful and to encourage animals to carry out these behaviors to their benefit in the long term.

Conclusion

In conclusion, this study suggests that dogs engaged in problem solving activities, appear to be less stressed after the housing in a boarding kennel dogs. However, some methodological considerations need to be stressed. Notably, the dogs' welfare needs to be carefully considered: it is important that dogs feel free to engage in the problem solving task without feeling distress and/or frustration.

The frustration may occur because an animal is denied access to something that it wants and so is thwarted in its efforts to obtain that resource (Mills et al., 2013). However, these problem solving tasks help the dogs to be self-confident and enhance their performance. This study may be considered as a first step toward further investigations on the problem solving tasks for improving animal welfare in boarding kennels dogs.

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I giochi di "problem solving" come strumento per aumentare il benessere di cani ospitati in pensione

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Sintesi

Soggiornare nelle pensioni, anche per brevi periodi, può essere una esperienza stressante per i cani a causa del nuovo ambiente, nuove persone e della separazione dalle figure di attaccamento. Per migliorare il loro benessere si potrebbero sottoporre a dei giochi di "problem solving", poiché è stato dimostrato che il gioco individuale, come la risoluzione dei problemi, può migliorare le capacità fisiche e cognitive di un individuo e quindi il suo benessere.

Lo scopo del presente lavoro è stato quello di valutare se i giochi di attivazione mentale possano diminuire lo stress nei cani ospitati nelle pensioni.

Lo studio è stato effettuato su 30 cani di differenti razze che hanno alloggiato per 5 giorni presso "Pet Hotel" Lucca. Questi sono stati suddivisi in due gruppi, uno composto da 15 soggetti (36±46,16 mesi) che hanno svolto attivazione mentale (PSG), con giochi di tre diversi gradi di difficoltà, una volta al giorno e per l'intera durata del soggiorno e il gruppo controllo (CG) composto da 15 soggetti di 30±41,93 mesi. Ai proprietari dei due gruppi è stato somministrato un questionario all'arrivo in struttura e dopo due giorni dal ritorno a casa, per valutare la variazione dei comportamenti di stress dei cani.

L'analisi statistica ha evidenziato che il PSG ha mostrato una diminuzione dei comportamenti di stress quali: attaccamento al padrone (W=-2,831; P=0,019), produzione di forfora (W=-2,440; P=0,041) e vocalizzazioni (W=-1,998; P=0,061), ed in generale una diminuzione del livello di stress alto. Nel CG sono stati osservati in aumento i comportamenti: attaccamento (46,67%) e vocalizzazioni (53,33%) ed un generale aumento del livello alto di stress (W=-2,236 $p<0.025$).

Questo studio pilota ha mostrato un miglioramento dello stress nel PSG che potrebbe essere imputabile alla capacità del problem solving di ridurre gli stati emotivi negativi, aumentando il benessere dei cani.

The use of nutraceuticals in the behavioral medicine of the dog: preliminary results

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Veterinary behaviorist freelancer

Abstract: Aim of this research was to assess the use of nutraceuticals (Zilkene®, Adaptil tablets®, Anxitane®, Calmex® and Calm diet®) in the behavioral medicine of the dogs, comparing the experience of veterinary behaviorists and general veterinary surgeons, by using an online questionnaire. One hundred and eighty six questionnaires were collected, 104 from veterinary surgeons and 82 from veterinary behaviorists.

As regards the situations in which the nutraceuticals are prescribed, these were situations of acute stress, such as those caused by fireworks, thunderstorms and travels. The veterinary behaviorists have usually prescribed the nutraceuticals in case of fireworks and thunderstorm phobia.

A good percentage of veterinarians was satisfied with the results obtained with the use of neutraceutics and this satisfaction was also shown by most of the owners.

In conclusion, the use of nutraceuticals in veterinary medicine is now widespread and appreciated by both veterinary behaviorists and veterinary surgeons.

Key Words: dog; nutraceutical; behavior.

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Introduction

In recent years there has been a widespread use of nutraceuticals also in veterinary medicine. Nutraceutical is the association of the terms "nutrition" and "pharmaceutical" and is considered as a food or food product that can offer both health and medical benefits for the prevention and treatment of disease. The term was first coined in 1989 by Stephen DeFelice, founder and chairman of the Foundation for Innovation in Medicines (Sharif & Khalid, 2018).

Under this definition, nutraceuticals at least comprise medical foods, functional foods, and dietary ingredients. Medical foods are usually administered under the supervision of a physician for the management of a disease. Functional foods and medical foods are actually not distinct, except that functional foods provide additional benefits for decreasing the risk of disease or ensuring optimal health. Lastly, another type of nutraceutical, dietary supplements, often include multiple forms of ingredients, such as vitamins, minerals, herbs, amino acids, and other substances that are administered for health (Mao et al., 2018).

The most commonly used nutraceuticals are probiotics, prebiotics, dietary fiber, antioxidants, phytoestrogen, saponins, carotenoids, phytochemicals, fatty acids, phenolics, isoprenoids, lipids, proteins, and herbs.

Considering the health benefits, the impact of nutraceuticals offering several health benefits and an alternative to contemporary medicine in improving the quality of health is immense.

Aim of this research was to assess the use of nutraceuticals in the behavioral medicine of the dogs, comparing the experience of veterinary behaviorists and general veterinary surgeons.

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Materials and methods

For the research a questionnaire on the use of nutraceuticals, which was distributed on-line to behavioral veterinarians and general veterinarians between January and December 2016, was used.

The questionnaire was formed by a first part about the use of nutraceuticals in behavioral problems, a second part, more specific, about the use and efficacy of every substance (Tab. 1) and a third part about the compliance of the dog owner.

Table 1. Commercial name and composition of nutraceuticals objects of the research.

Commercial name of nutraceutical	**Composition**
Zylkene®	Alpha-casozepine
Adaptil tablets®	GABA, L-theanine, L-tryptophan and B vitamins
Anxitane®	Suntheanine®
Calmex®	L-Theanine, L-Tryptophan, Piper Methysticum, B vitamins
Calm diet®	Alpha-casozepine, L-Tryptophan

Results

In the present survey 186 questionnaires were collected, 104 from veterinary surgeons and 82 from veterinary behaviorists.

In the Fig. 1 are reported the percentages of veterinarians who have prescribed the nutraceuticals during their clinical activity.

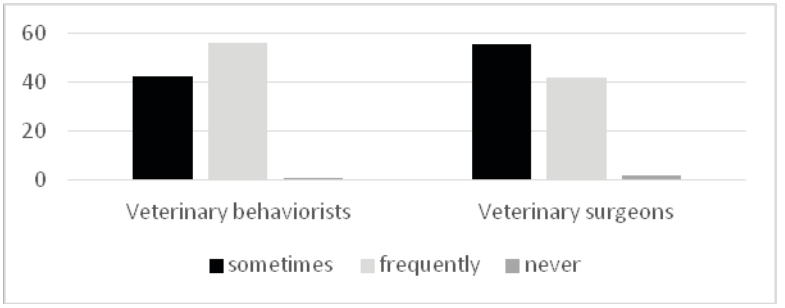

Fig. 1. Percentages of veterinary surgeons and veterinary behaviorists who have prescribed nutraceticals.

In the Fig. 2 are instead reported the principal reasons that cause the prescription of a nutraceutical.

A high number of veterinary surgeons (66%) and veterinary behaviorists (59.5%) was satisfied with the results obtained with the use of these substances.

The percentages with which the nutraceuticals, subject of this research, were prescribed are shown in Fig. 3.

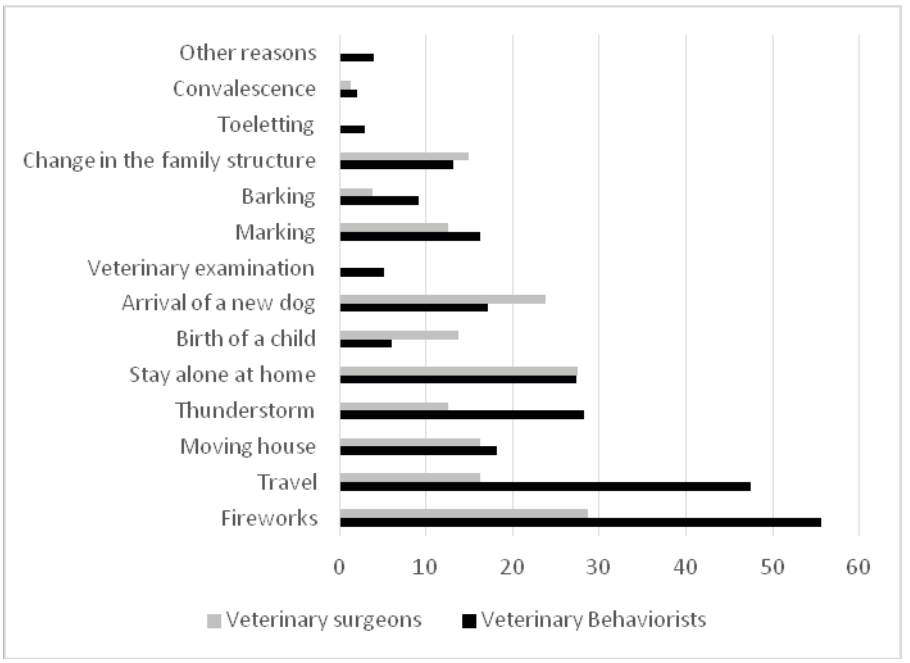

Fig. 2. Principal reasons for prescribing a nutraceutical.

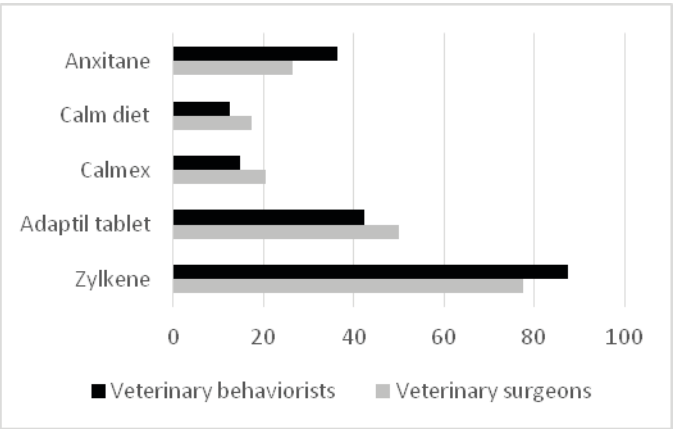

Fig. 3. Percentages of prescription of nutraceuticals.

As regards owner compliance, the proposal to use the nutraceutical was positively considered by the 79.4% of the clients of the veterinary surgeons and the 90.5% of those of the behaviorist veterinarians, also if the cost of these product was considered more expensive by 52.6% of the clients of veterinary surgeons and 75% of those of veterinary behaviorists.

Discussion

These preliminary data show that the use of nutraceuticals is widespread both among veterinary surgeons and veterinary behaviorists. These substances are therefore important means to facilitate the success of behavior modification therapies too. As regards the situations in which

the nutraceuticals are prescribed, these are situations of acute stress, such as those caused by fireworks, thunderstorms and travels. Moreover, the veterinary behaviorists particularly prescribe the nutraceuticals in case of fireworks and thunderstorm phobia.

As regards the choice of nutraceuticals, there were no differences between the two categories of professionals, with a more frequent use of some products that have been on the market for a long time (Zylkene®) or proposed for use in association with other substances (pheromones).

It is also important to underline how a good percentage of veterinarians was satisfied with the results obtained with the use of neutraceutics and how this satisfaction was also shown by most of the owners.

In conclusion, the use of nutraceuticals in veterinary medicine is now widespread and appreciated by both veterinary behaviorists and veterinary surgeons. Research in this area is evolving, even with regard to long-known chemical compounds, such as tryptophan. A recent study has, in fact, shown that it is possible, also in dogs, to increase its bioavailability, by modifying the diet (Torracca & Casini, 2017).

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L'uso di nutraceutici nella medicina comportamentale del cane: risultati preliminari

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Sintesi

Lo scopo della ricerca è stato quello di valutare l'uso di nutraceutici (Zilkene®, Adaptil compresse®, Anxitane®, Calmex® e Calm dieta®) nella medicina comportamentale del cane, paragonando l'esperienza di veterinari esperti in comportamento e di veterinari generalisti, attraverso un questionario on-line.

Per la presente ricerca sono stati raccolti 186 questionari, 104 compilati da veterinari generalisti e 82 da veterinari esperti in comportamento.

I nutraceutici sono prescritti soprattutto dai veterinari esperti in comportamento in situazioni di stress acuto, come quelle provocate da fuochi di artificio, temporali o viaggi.

Un buona percentuale di veterinari è soddisfatta dei risultati ottenuti con l'uso di queste sostanze e questa soddisfazione è mostrata anche dai proprietari.

In conclusione, l'uso dei nutraceutici in medicina veterinaria è largamente diffuso ed apprezzato, sia dai veterinari esperti in comportamento, sia dai veterinari generalisti.

A review on the effects of sensory stimulation in shelter dogs

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Abstract: Millions of dogs enter public and private shelters every year. Shelters are often very stressful environments to dogs, which are kept in very limited space and are impeded to appease their social motivations. Furthermore, the environmental stimuli provided are generally quantitatively – hyper/hypo-stimulation – and qualitatively inadequate. In such conditions dogs are likely to develop abnormal behaviors as maladaptive coping strategies that are not only a symptom of low welfare, but they also drastically decrease their chances of being permanently adopted. Environmental enrichment, such as training sessions, additional cage furniture and food-filled toys have been shown to decrease levels of stress in confined dogs. However, many of these programs require a noticeable financial and time commitment. Unfortunately, many shelter running institutions lack necessary funds, personnel and time to provide their dogs with complex environmental enrichment programs. In this light, sensory stimulation may represent a scientifically valid, low-cost and no time-wasting instrument to enhance the average level of welfare of shelter dogs, limit the development of behavioral problems and increase dog adoptability.

Key Words: dog; shelter; sensory stimulation.

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Introduction

Dog straying still is a very diffuse problem worldwide. The number of dogs entering, every year, public and private shelters is still very high. For instance, in 2015, 100.194 dogs entered a public shelter, in Italy only (LAV, 2015). In 2016 approximately 3.3 million dogs entered a shelter in the U.S. (ASPCA, 2016) and other 45.256 entered an RSPCA shelter in Australia (RSPCA, 2016). Despite the efforts made to guarantee their adoption some of these dogs may spend all their life in confinement. Due to the lack of funds and personnel, shelters are rarely capable of providing adequate levels of welfare to the dogs housed (Wells, 2004; Protopopova, 2016), which are therefore forced to live in highly stressful environments (Rooney et al., 2007; Rooney et al., 2008) until they are either adopted, euthanized or die due to natural causes. Environmental enrichment has been widely investigated as a tool to reduce physiological and behavioral signs of chronic stress induced by confinement in laboratory dogs (Hubrecht, 1993) and dogs housed in rescue shelters (Wells et al., 2002a). The currently acknowledged classification of the types of enrichment for dogs, as well as for other species, identifies two major categories of enrichment, namely animate and inanimate. Animate enrichment may as well be defined as social enrichment and comprises any type of social stimulation whether intraspecific – other dogs in the case of kennelled dogs – or interspecific – humans or other species (Wells, 2004). On the other hand, inanimate enrichment entails four subcategories that can be addressed as follows: occupational enrichment – or enrichment through the provision of toys (Doring et al., 2016) –, feeding or nutritional enrichment (Bosch et al., 2007; Schipper et al., 2008), physical enrichment – described as

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cage furniture by some authors (Wells et al., 2004) –, and sensory enrichment, which comprises auditory, olfactory and visual stimulation (Wells et al., 2004; Ellis, 2009), but also tactile and taste stimulation. Recently, the use of pheromones as enrichment tool has gained interest among scientists, especially as far as companion animals are concerned (Kokocinska et al., 2016). While none of these aspects should be overlooked to achieve optimal welfare standards, reality shows that shelters rarely have the means to provide their dogs with complex enrichment programs. In this light, sensory stimulation protocols based on population preferences may represent a feasible and inexpensive way to enhance the average level of welfare of shelter dogs, limit the development of behavioral problems and increase dog adoptability. This approach may also allow shelters to employ their resources for the treatment of the most problematic individuals. This paper aims to provide an updated review on the effects of sensory stimulation as enrichment tool in shelter dogs, with a focus on auditory, visual, olfactory and pheromone stimulation. Scientific studies that investigated taste and tactile enrichment in shelter dogs have not been found. Indeed, some level of sensory stimulation is part of any type of enrichment. However, it may be difficult to assess the effects induced by the stimulation of a single sense when providing dogs with complex enrichment protocols that operate on more than one sensory channel at the time. For this reason, this review will follow the abovementioned classification and will consider only those studies that investigated the effects of a pure sensory stimulation. Finally, the effects of sensory stimulation on the rate of adoption success will be discussed.

Auditory stimulation

Using auditory stimulation as a means for enrichment in dogs kept in very noisy environments, as shelters usually are, is a very delicate task. Since high noise levels have been identified as a possible cause of poor welfare in kennelled dogs (Sales et al., 1997), it is important, when providing auditory enrichment, to choose the right stimulus and avoid adding even more noise to the environment. Noisy machineries and procedures in laboratory environments have been proven to alter cardiovascular, endocrine and reproductive systems as well as affect communicative behaviors of kennelled animals (Turner et al., 2007). However, Sales et al. (1997) reported barking rather than routine procedures as the main source of noise inside kennels. Regardless the source, ambient noise may be altered by using other auditory stimuli with relaxing effect (Overall & Dyer, 2005). One may think that auditory stimulation operates by muffling a meaningful arousing stimulus (i.e. people talking or other dogs barking) with a less, if at all, species-significant stimulus (i.e. music). However, as Wells (2009) points out, if it were the only process involved, one would expect any types of auditory stimulation to have the same efficacy at reducing barking. But this is not the case. A study by Wells et al. (2002b) investigated the effect of five types of auditory stimulation (human conversation, classical music, heavy metal music, pop music, and a control) on the behavior of 50 shelter dogs. Results showed that dogs spent more time in activities indicative of relaxation (more time resting, less time standing, less time vocalizing) when classical music was played. On the contrary, behaviors suggestive of anxiety (i.e. body shaking and barking) increased during heavy metal music sessions than when any other stimulus was played. A more recent study by Kogan et al. (2012) led to similar results as dogs spent less time vocalizing when one of the four classical music selections was played, and more time shaking when heavy metal music was played. Differences were found in the time spent vocalizing, which was longer during control periods than during any other stimulus, heavy metal included. Interestingly, a modified soundtrack, psychoacoustically designed with the purpose of inducing a soothing effect on dogs elicited minimal behavioral changes. Similarly, Bowman et al. (2015) found that, when classical music was played, dogs spent more time lying, less time standing and less time vocalizing. They also deeply investigated the effects of music on physiological indicators of stress, such as HRV (heart rate variability)

and salivary cortisol. Mean heart rate decreased in the initial response of dogs to music. Changes in HRV parameters were suggestive of an increased activity of the parasympathetic system and a decreased activity of the sympathetic system as a consequence of environmental enrichment. Also, lower cortisol levels were associated with the initial phase of auditory stimulation, although this latter result was not statistically significant. Furthermore, they found out that dogs rapidly habituated to the enriching stimulus, so that music lost its calming effect within two days of exposure. This finding suggests that, in practical application, the music playlist used should be frequently varied or perhaps alternated with other types of enrichment in order to be effective in the long term. In confirmation of that, a more recent study by Bowman et al. (2017) demonstrated that the habituation process can be minimized by alternating different genres of music.

Although both of these studies were set inside actual shelters with hundreds of dogs, the terms "no music" and "silence" are used interchangeably by the authors (Kogan et al., 2012; Bowman et al., 2015). Because of the presence of so many dogs within the experimental setting it is likely that the two captions do not correspond, unless the subjects included in the study had been acoustically isolated during the "silence" period. However, no mention of such a procedure has been found in their papers. This may also explain why dogs spent the most time vocalizing during control periods in the study by Kogan et al. (2012). A hypothesis may be that the absence of music, allows background noises, supposedly barking, to be better heard by other dogs, which in turn, respond to the triggering stimulus.

Recently, Brayley & Montrose (2016) investigated the effects of audiobooks on the behavior of 31 shelter dogs. Their study revealed that audio-book stimulation was more effective than pop, classical and psycho-acoustically designed music, at reducing barking behavior. In addition, it resulted in dogs spending more time resting or sleeping and less time sitting or standing than in any other condition and less time walking than in other conditions except classical music. These findings are somewhat contrasting with those by Wells (2002a) in which shelter dog behavior was not affected by human conversation. This may be explained by the fact that shelter dogs are likely to be hearing human voices in the form of conversation, everyday. On the contrary, they are not used to hear human voices with the typical features of the narrative style, which is characterized by a "clear and strong enunciation, a steady pace and tempo and a non-monotonous or stilted delivery" (Brayley & Montrose, 2016). Therefore, it seems plausible that, in a shelter context, human voice is not an enriching stimulus per se, but its efficacy at reducing behavioral signs of stress in dogs is strictly linked to the way it is presented. Since the mechanism with which auditory stimulation affects dog behavior is not thoroughly understood, a more rigid experimental setting that allows to rule out background noise intensity and type variables, should be used in future studies (Kogan et al., 2012). For instance, by artificially altering the intensity of the background noise, it may be possible to understand how much of the effect of classical music is due to its own relaxing properties and how much is due to its buffering effect on arousing noises. Moreover, since barking has a proven communicative function (Yin & Mc Cowan 2004), reducing the perception of barking to a level that it loses its communicative significance may have welfare implications in itself (Sales et al., 1997). This aspect should be carefully considered when providing shelter dogs with enriching auditory stimuli.

Visual stimulation

While it has been widely investigated in other captive species, especially in non –human primates (Brent & Stone, 1996; Lutz & Novak, 2005; Ogura, 2012), sight-based enrichment in dogs has never been studied in depth. There are three key issues that obstacle the use of this type of enrichment in dogs. First, as they do not have a trichromatic vision – as humans do –, the choice of proper colors becomes challenging for researchers and shelter operators (Pongracz et al., 2003).

Second, televised images may be perceived as rapid flickering by dogs, as they have a flicker fusion frequency 10 to 30 Hz higher than television refresh rates (Coile et al., 1989; Graham et al., 2005b; Wells, 2009). Third, bi-dimensional images may not trigger a response simply because their content is not perceived by dogs as it is by humans (Graham et al., 2005b). As for this latter aspect, there is scientific evidence that dogs do recognize the content of bi-dimensional images. Fox et al. (1971) discovered that dogs would sniff a life-size painting of a conspecific in the same areas as they would sniff a real 3D dog. More recently, Pongracz et al. (2003) found out that dogs correctly respond to gestural and verbal indications given by a life-size bi-dimensional video-projected image of a human. However, the complexity and the dimension of the broadcasted images may play a role at affecting dogs' perception of the image content (Zeil, 2000; Pongracz et al., 2003). The only experiment with televised images as a means of enrichment in shelter dogs was carried out by Graham et al. (2005b). They found out that vocalizations and moving behavior were significantly lower in all four experimental conditions, during which the tv broadcasted either images of moving humans, conspecifics, interspecifics or was blank, than in control condition, during which the tv monitor was moved out of the dogs' sight. Also, dogs spent more time in the front part of the kennel, which was closer to the screen, in all experimental conditions than in the control condition. As the authors point out, these results suggest that the sole presence of a novel object (tv monitor), rather than the nature of the images broadcasted, might have been the reason for behavioral modification (Graham et al., 2005b). However, they did find out that dogs spent more time watching images of moving humans, conspecifics and other species than they did with a blank screen, especially in the two former conditions. This data suggests that dogs are attracted to tv images and that they probably perceive the differences among the image contents, as well. Despite that, in this study dogs spent only 10.8% of the total observation time, looking at the tv screen, suggesting a relatively low interest in the visual stimulation. Perhaps, the small size of the screen, which was only 14'' wide, might have affected dogs' perception and/or interest towards the visual broadcast. Plus, in shelters, humans and conspecifics are a common visual stimulus to every dog, and this might also have influenced dogs' response to the images. Finally, as it was reported for other types of enrichment (Bowman et al., 2015; Bowman et al., 2017), dogs seemed to habituate to the enriching stimulus, as both behavioral changes and interest towards the tv monitor gradually decreased throughout the time of the experiment (Graham et al., 2005b). Despite not completely satisfying scientific results, some shelters already use this type of enrichment, basing their decision on empirical evidence that some dogs react to visual stimuli (Wells, 2004). However, among all types of sensory enrichment, visual stimulation is the least scientifically supported, the most financially demanding and time consuming for shelter staff. In fact, legitimate concern has been raised in relation to the provision of visual stimuli that can be seen but not physically reached by dogs. The impossibility to reach the stimulus may cause frustration rather than positive interest (Taylor & Mills, 2007).

Olfactory stimulation

It is very well known that dog perception of the environment relies mostly on the sense of smell (Horowitz et al., 2013). Depending on management practices, this sense may be either hypo-stimulated or hyper-stimulated in a shelter environment (Taylor & Mills, 2007). Shelter odor sources are mainly represented by other dogs and cleaning products (Taylor & Mills, 2007). Especially the latter are unlikely to be particularly pleasant for dogs. However, it is quite surprising that, to date, the effects of olfactory stimulation as enrichment in kennelled dogs have rarely been studied. Enriching olfactory stimuli may be classified as either biologically relevant, such as blood, urine and feces from other species or biologically meaningless, such as herbs used in aromatherapy (Wells, 2009). Although, biologically relevant odors have been proven to be an effective enrichment tool

in captive species of canids (Nilsson et al., 2014), they have never been scientifically tested in shelter dogs for such a purpose. Indeed, possible transmission of viruses, bacteria, parasites and fungi raises concern for the practical use of biological material as enrichment in shelters. On the other hand, herb odors are safer from this point of view and there is plenty of data that demonstrate their enriching effects in both wild – African lions (Pearson, 2002), black-footed cats (Wells & Egli, 2004) bobcats (Bol et al., 2017), gorillas (Hepper & Wells, 2012), mice (Umezu et al., 2001) birds of prey (Nelson Slater & Hauber, 2017) –, and domestic species – cats (Ellis, 2009; Ellis & Wells, 2010) and dogs (Wells, 2006). Nevertheless, so far only one study investigated the effects of aromatherapy in shelter dogs. Graham et al. (2005a) analyzed the behavior of 55 shelter dogs during exposure to 4 essential oils, namely chamomile, lavender, peppermint and rosemary. According to previous results with studies on humans (Motomura et al., 2001; Amsterdam, 2012) chamomile and, to a greater extent, lavender resulted in dogs spending more time performing behaviors suggestive of relaxation. Specifically, they spent less time moving and more time resting than in any other experimental condition. On the contrary, and always in accordance with studies on humans (Moss et al., 2003) peppermint and rosemary resulted in a greater amount of behaviors suggestive of alertness, like moving, standing and vocalizing. In contrast with the results from studies on acoustic (Bowman et al., 2015; Bowman et al., 2017) and visual stimulation (Graham et al., 2005b), dogs seemed not to habituate to the olfactory stimuli and behavioral changes lasted or even increased throughout the experimental period.

Pheromone stimulation

Pheromones are chemical signals released into and received through the environment by individuals of the same species (Pageat & Gaultier, 2003) These signals are detected thanks to an auxiliary olfactory organ called vomeronasal organ, which is known to be highly developed in dogs (Coli et al., 2016). Specifically, the Dog Appeasing Pheromone (DAP) is a synthetic analogue of the pheromone secreted by the intermammary glands of the lactating bitch, from 3-4 days after parturition to 2-5 days after weaning (Pageat & Gaulitier, 2003).

The efficacy of DAP at improving emotional states and reducing stress-related behaviors in anxiety-evoking situations has been repeatedly tested and confirmed. A calming effect has been reported in dogs exposed to loud noises (Levine et al., 2007; Landsberg et al., 2015), car travels (Estellés & Mills, 2006), training sessions (Denenberg & Landsberg, 2008), isolation (Gaultier et al., 2008) and the veterinary clinic environment (Mills et al., 2006; Kim et al., 2010; Siracusa et al., 2010). Only two studies could be found in the literature that investigated the effects of DAP in the shelter environment. Tod et al. (2005) investigated the effects of a DAP diffuser on a group of shelter dogs over a 7-day experimental period, during which they tested the dogs for behavioral responses towards a stranger walking up and down the kennel block, a stranger approaching neutrally and a stranger approaching friendly. Results showed that, when dogs were tested for a distraction – a stranger crossing the kennel block – the mean barking amplitude in the DAP treatment group significantly decreased across the 7 experimental days. However, no differences were found in the peak barking amplitude in the DAP treatment group before and after the 7-day pheromone exposure.

On average, there was a 20dB difference in the mean barking amplitude between the DAP and the placebo group. Also, the dog recovery capability to return to a lower state of arousal after the stimulus, seemed to be enhanced by exposure to DAP. The DAP treatment group showed a significant reduction in the mean barking amplitude during recovery period over the 7-day pheromone exposure, if compared to the placebo group. However, no difference was found in recovery data for the DAP treatment group before and after exposure to DAP. As for the neutral stranger test, no significant differences were found in dog behavioral responses – body posture, motor

activity, sniffing, barking, growling, whining, escape behaviors – between the two groups. On the contrary, a significant increase in the frequency of sniffing and resting behavior and a decrease in barking behavior were found in the DAP treatment group during the friendly stranger test, following 7 days of exposure to DAP. The overall results from this study suggest that DAP may be used to reduce the intensity and the frequency of some stress-related behaviors in shelter dogs (Tod et al., 2005). For instance, as the main source of environmental noise in shelters are the dogs themselves (Sales et al., 1997), decreasing sound pressure levels induced by barking in response to a passing stranger may have important welfare implications (Taylor & Mills, 2007). Furthermore, behavioral responses to arousing stimuli seem to be affected by exposure to DAP. In fact, results from the friendly stranger test show an overall lower level of arousal in dog responses to the experimenter's engaging gestures. However, the frequency of many stress-related behaviors was the same in both the DAP and the placebo group in all the tests. A more recent study on the effects of pheromone collars by Grigg & Piehler (2015) found no significant difference in the proportion of time spent in stress-related behaviors between the experimental and the control group. The only difference reported was a non-significant increase in the proportion of time spent resting by the experimental group when wearing collars. However, this study was conducted on a sample of only eight dogs. Furthermore, each dog was subjected to different manipulation experiences during the experimental period, as they all were used for teaching purposes. Indeed, the absence of significant differences may simply be attributed to the ineffectiveness of DAP collars, however a not complete standardization and the small study sample may have affected the results of their study (Grigg & Piehler, 2015).

As Tod et al. (2005) pointed out in the conclusive paragraph of their study, limited control over some variables, such as husbandry procedures or dog re-homing, destruction or introduction of new dogs in the kennel block, as well as a limited sample size or the use of dogs for teaching labs – as in the study by Grigg and Piehler – should be avoided in future studies in order to obtain more consistent and irrefutable results.

Effects of sensory stimulation on the success of adoption

Sheltered dogs may benefit from the provision of sensory stimulation in two ways. A direct effect is that of improving dogs' welfare during the time spent at the shelter, which is particularly important for those individuals that, due to undesirable aesthetical, behavioral or age features, are destined to spend the rest of their lives inside a kennel (Weiss et al., 2012). On the other hand, for those dogs that do have the chance to find a new owner, sensory stimulation may also play a key role at increasing dog adoptability. Previous studies have reported that relinquishment may induce the dog to progressively develop behaviors that are potential stress indicators, such as whining and scratching doors (Cozzi et al., 2016) as well as excessive barking and panting (Stephen and Ledger, 2005), or symptoms of frustration and depression, such as wall bouncing, repetitive oral behaviors, pacing and circling (Stephen & Ledger, 2005) and apathetic responses to play stimuli (Cozzi et al., 2016). These behaviors may negatively affect the success of adoption (Protopopova, 2014) by 1) reducing the dog perceived desirability when potential adopters visit the shelter, 2) leading to re-kenneling due to behavioral problems.

Sensory stimulation and shelter dog desirability

People looking to adopt a dog from a shelter seem to prefer individuals showing quite specific behavioral features at the moment of adoption (Wells & Hepper, 2000a). Dogs will more likely be selected for adoption if they occupy the front side of their cage, if they are alert but quiet and

if they interact with the potential adopter in a friendly manner (Wells & Hepper, 2000a; Marston & Bennett, 2003). Sensory stimulation has been used to encourage these types of behavior. A decrease in barking behavior has been reported in studies on all types of sensory stimuli (Bowman et al., 2015; Graham et al., 2005a; Graham et al., 2005b; Tod et al., 2005). Alertness in the form of increased sniffing behavior has been reported by Tod et al. (2005) in their study on the effects of pheromones. An increased proportion of time spent in the front part of the cage has been reported by Graham et al., (2005b) after a visual stimulus was placed in the same area. Therefore, the location inside the pen in which the stimulus is placed may be relevant for enhancing dog desirable behaviors and improve adoptability. However, among all the studies on sensory stimulation in shelter dogs, only Graham et al. (2005b) investigated this aspect, so far.

When visiting a shelter, potential adopters usually have no more than a few minutes to interact with each dog. Therefore, it is important for dogs to feel comfortable in the presence of humans and show desirable behaviors also in that brief period of time during which the interaction takes place. Regardless the fact that some dogs may perceive visitors as a frightening stimulus while others may perceive them as a craved unreachable stimulus, the best way to promote positive dog-human interactions is to provide the dogs with daily training sessions or dog-human interactions (Conley et al., 2014; Herron et al., 2014). Despite that, sensory stimulation may be used as an adjunctive treatment to reduce the abovementioned states of fear or frustration induced by human presence, as proved by Tod et al. (2005) in their experiment with pheromones.

However, data on the efficacy of sensory stimulation at promoting positive shelter dog-human interactions are still lacking for olfactory, visual and acoustic stimuli.

Sensory stimulation and shelter dog behavioral problems

As a matter of fact, "behavioral problems" are the most common explanation given by owners when returning a dog to the shelter, accounting for 22% to 89% of all the returns worldwide (Marston et al., 2004; Mondelli, 2004; Diesel et al., 2008; Wells & Hepper, 2000a). Furthermore, behaviors displayed inside the shelter have been correlated to problem behaviors in the new household in different ways. For instance, Van der Borg et al. (1991) found that behaviors observed in shelters may predict the display of problem behaviors after adoption and Wells & Hepper (2000) found that dogs adopted from shelters are more likely to present behavioral problems in the new house, such as destructive behavior and hyperactivity. It is plausible that experiencing the shelter environment may induce behavioral changes that persist even after adoption in the form of undesirable behaviors. The efficacy of sensory stimulation at reducing the level of stress and preventing or limiting the development of stress-related behaviors, such as excessive vocalization, hypermotility and hypervigilance during kenneling (Bowman et al., 2015; Brayley & Montrose, 2016; Graham et al., 2005a; Graham et al., 2005b, Tod et al., 2005) may facilitate the integration process into the foster family.

Furthermore, stress induced by passing from a shelter environment to a new home should not be overlooked (Osella et al., 2016). Undesirable behaviors shown by the dog during the first week of adoption may play a critical role in deciding whether it will be re-kennelled or not (Mondelli et al., 2004). When provided in the new household, some types of sensory stimulation may help the dog cope with a totally different environmental and social condition and help build the bond between the dog and the new owner (Osella et al., 2016). For instance, Osella et al. (2016) found that DAP, administered to the dogs immediately after adoption for two consecutive months, had, among others, a positive effect on behavioral signs of fear, such as panting/trembling and hiding in corners, on behavioral signs of separation distress, such as urinating or defecating in inappropriate places, and on behavioral signs of hyper-attachment, such as excessive contact-seeking behaviors and owner shadowing. All these behaviors are likely to be perceived as undesirable by

new owners and negatively affect the success of adoption. To date, no other type of sensory stimulation has been tested in dogs to assess whether they could be supported throughout the initial adaptation phase of the adoption process.

Conclusion

Adequate sensory stimulation is fundamental for an appropriate psycho-physical development and for the maintenance of minimum standards of psycho-physical welfare. When dogs are forced to live in an environment where sensory stimulation is either insufficient, excessive or qualitatively inappropriate, they are likely to develop abnormal behaviors as maladaptive coping strategies (Alberghina et al., 2017). Such behaviors are not only a symptom of low welfare but they also drastically decrease dogs' chances of being permanently adopted (Herron et al., 2014).

In order to be effective, sensory stimulation programs should not let dogs habituate to the stimuli provided (Bowman et al., 2015). This means that different types of stimuli should be alternated or, even better, other types of enrichment like positive dog-dog or dog-human interactions, should be provided (Normando et al., 2009).

In fact, sensory stimulation alone is far from being a sufficient means to achieve optimum welfare standards in shelter environments. Ideally, different types of environmental enrichment should be integrated (Herron et al., 2014) to create specific protocols for each individual. Unfortunately, many shelter-running institutions lack necessary funds, personnel and time to provide each dog with a unique environmental enrichment program. In this light, sensory stimulation may represent a scientifically valid, low-cost and no time-wasting tool to improve the average level of welfare of the shelter population and to allow shelter staff to employ more resources in focusing on individual needs. Visual stimulation may be an exception, since it seems to be neither inexpensive nor supported by enough knowledge on dog perception of bi-dimensional televised images (Graham et al., 2005b). However, despite the fact that current data generally supports the use of sensory stimulation to enrich the lives of shelter dogs, further research is needed in order to assess the effects of a greater pool of stimuli and comprehend the processes through which they modify dog behavior.

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Effetti della stimolazione sensoriale nei cani di canile

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Sintesi

Ogni anno milioni di cani entrano in canili pubblici e privati, luoghi spesso molto stressanti per gli animali che sono tenuti in spazi ristretti e privati della possibilità di soddisfare le loro motivazioni sociali. Inoltre, gli stimoli ambientali forniti sono in genere quantitativamente (ipo o iperstimolanti) e qualitativamente inadeguati. In queste condizioni è probabile che i cani sviluppino comportamenti anomali come strategie mal adattative di coping che non sono solo un sintomo di scarso welfare ma anche la causa di una drastica riduzione della possibilità che questi animali siano adottati.

L'arricchimento ambientale, come le sessioni di training, gli elementi aggiunti ai box, i giocattoli pieni di cibo, si sono dimostrati in grado di ridurre i livelli di stress nei cani ospitati in canile

Tuttavia, molti di questi programmi richiedono un notevole sforzo finanziario e di tempo. Sfortunatamente, molti canili non possiedono i fondi, il personale ed il tempo necessari per fornire ai propri cani un programma complesso di arricchimento ambientale. In questa luce, la stimolazione sensoriale può rappresentare uno strumento scientificamente valido, di basso costo, che non richiede un impiego considerevole di tempo per migliorare il livello medio di benessere del cane di canile, limitando, inoltre, l'insorgenza di problemi comportamentali ed aumentando l'adottabilità degli animali.

A case of thunderstorm phobia in a Maremma sheepdog

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Abstract: A 5-year-old neutered female Maremma sheepdog, probably crossed with a Retriever, was examined due to a severe phobia of thunderstorms and loud noises. Adopted in late summer, she immediately presented signs of thunderstorm phobia and nocturnal awakenings. For this reason, the owners immediately turned to a veterinary behaviorist, who recommended behavior modification training based on creating a safe zone, desensitization and counter-conditioning with general thunderstorm sound effects. The therapy seemed to have immediately an effective outcome immediately, thanks to the start of autumn and decreasing thunderstorms, however due to the return of spring the dog started to show the same symptoms again. During the second visit, performed by the author, videos of nocturnal awakenings and panic reactions associated with thunderstorms were evaluated. The diagnosis was of phobia of thunderstorms and loud noises, characterized by sporadic panic attacks. Behavioral modification therapy was continued and Adaptil Collar® was introduced and Alprazolam as needed was prescribed. After the first summer, the owners agreed to administer Clomipramine on an ongoing basis to prepare the dog for the next summer. In the presence of medium-intensity thunderstorms, behavioral manifestations were reduced to trembling only and symptoms of anxiety in response to a change in barometric pressure had almost disappeared. Finally, thanks to the results obtained and to meet the requests of the owners, the following year will be managed by stopping the therapy with Clomipramine and keeping the Alprazolam as needed.

Key Words: dog; thunderstorm phobia; Clomipramine; Alprazolam.

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Presentation

A dog was examined due to a severe phobia of thunderstorms and loud noises. Nocturnal awakenings, related and not related to night-time thunderstorms, were also reported.

The dog was a 5-year-old neutered female Maremma sheepdog, probably crossed with a Retriever, that weighed 35 kg.

History and presenting signs

The dog's owners were a childless couple who lived in a house with a garden in a quiet suburban area. The garden is not very large, but it is well fenced and secure and includes a sheltered dog house, which is used daily. The dog was adopted a year before the visit. During this year, she always lived in the same environment, free to enter the house but not the bedroom. During the absence of both owners, approximately for half the day, the dog was often left in the garden. Before being adopted, the dog underwent four family changes because of her tendency to escape, especially during thunderstorms. Information about previous owners was unclear but it was reported that, in all four cases, she was always left outside all day, free or, in some cases, chained. Since she has been living with her current owners, she has never escaped and she has never tried to.

Adopted in late summer, she immediately presented signs of thunderstorm phobia and noc-

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turnal awakenings. For this reason, the owners immediately turned to a veterinary behaviorist, who recommended behavior modification training based on creating a safe zone, desensitization and counter-conditioning with general thunderstorm sound effects. The therapy seemed to have immediately an effective outcome immediately, thanks to the start of autumn and decreasing thunderstorms, however due to the return of spring the dog started to show the same symptoms again.

The owners, unable to manage the problem, especially the nocturnal awakenings, contacted a second veterinary behaviorist.

During the second behavioral consultation, videos of nocturnal awakenings and panic reactions associated with thunderstorms were evaluated. The symptoms found on video were: restlessness, hypersalivation, tachypnea, pacing, whining, attempts to leave the house, scratching at the door, attention-seeking. It was reported that, in severe cases, the dog vocalizes and manifests intense attempts to escape confinement, destroying the entrance door to go out into the garden and even jumping on furniture. In these cases, when the owners opened the front door, supporting the dog requests, she went out, sniffed the air, urinated but then she immediately returned into the house and, if the owners closed the door, she asked to go out again and again. Owners were also required to videotape the dog in their absence, because a comorbidity of separation anxiety and thunderstorm phobia have been reported (Overall et al., 2001).

Direct observation: the dog appeared sociable, not fearful or suspicious of strangers, not particularly reactive or impulsive. The level of obedience and self-control was good. Intraspecific social behavior, assessed during the socialization classes by the second instructor, appeared to be a little insecure, physical and basically impositive. Aside from the tendency to play physically, both with people and with dogs, other behaviors, centripetal, centrifugal and mixed did not present relevant elements.

Physical Examination Findings and Laboratory Results

Through a careful physical examination it was still possible to notice the area of the tail that the bitch used to bite immediately after adoption, but there were no more injuries. Other than that, the patient was in good health and had no palpation pain. Indeed, as suggested by Lopes Fagundes et al. (2018) and as already demonstrated in humans (Vlaeyen et al., 2000; 2012), painful conditions and the development of fear-related avoidance responses could be related. Blood count, biochemical and extended thyroid profile (determination of TSH, FT4, FT3 and rFT3 with FT4, FT3 and rFT3 in LC-MS-MS) were normal. Gastrointestinal symptoms were absent.

Diagnosis

Taking into account the dog's history and behavioral symptoms, the diagnosis was of phobia of thunderstorms and loud noises, characterized by sporadic panic attacks. The anticipation of the stimulus and the anxiety occurred only in the summer (approximately June to September), when the thunderstorms aroused with increased frequency and intensity. If the storms were present for a series of consecutive days, nocturnal awakenings and other anxious symptoms were manifested even in the absence of the storm itself. The phobia of noises was limited and substantially related only to fireworks or, in any case, to noises of very high intensity. Separation anxiety was not found.

A phobia has been defined as "an intense fear response that is out of proportion/excessive for the degree of threat in a given situation" (Beaver, 1999); this response can become worse with repeated exposure to that stimulus (Beaver, 1999). Thunderstorm phobia may be classified as a form of noise phobia (Beaver, 1999); however, some researchers have differentiated thunder-

storm phobia from fear of other noises because some dogs appear to react to other thunderstorm-related phenomena such as a change in barometric pressure (Houpt, 2005), ionization, static field, and even odors (Shull-Selcer and Stagg, 1991; Campbell, 1992; Overall, 1997). Clinical signs of thunderstorm phobia include panting, pacing, hiding, shaking, dilation of the pupils, salivation, lack of appetite, owner-seeking behavior, attempt to escape confinement, and inappropriate elimination (McCobb et al., 2001).

From a prognostic point of view, total resolution of thunderstorm phobia, that is, a dog totally calm in the midst of severe weather conditions, is probably not a realistic goal (Crowell-Davis, 2003). Given the current ineffectiveness of coping with stress, the panic attacks and symptoms related to anxiety, currently present only during the summer, there were concerns of an evolution to a generalized anxiety with possible emergence of substitutive activities or compulsive behaviors (Hewson & Luescher, 1999; Overall & Dunham, 2002).

Treatment

This type of phobia is difficult to treat (McCobb et al., 2001), though some limited success has been reported with both traditional behavioral modification techniques and drug therapies (Shull-Selcer & Stagg, 1991; Campbell, 1992; Voith & Borchelt, 1985). Treatment of storm phobia has historically included behavior modification: specifically, desensitization and counter-conditioning (DSCC), medication, or a combination of both (Houpt, 2005; Overall. 2002; Shull-Selcer & Stagg, 1991). However, specific reports assessing improvement in a quantitative manner are lacking (Crowell-Davis, 2003).

In addition to the traditional behavioral modification techniques of the first behaviorist, owners were advised to give the dog access to the sleeping area and to create a second safe zone there. The previous attempts to create a safe zone in the living room, denying access to the sleeping area, had not proved effective. The dog carrier introduced by the first behaviorist, despite the work of the owners, was still not used regularly by the dog so it was recommended to implement the work of habituation and, in the meantime, to insulate the carrier to reduce the perception of noise inside.

Furthermore, it was advisable to regularize the subject's routine in order to increase the predictability of the events and, to facilitate the forecast of thunderstorms, it was suggested to place one or more barometers in the home. In the meantime, the trainer's work was focused on differential reinforcement of other behavior, relational aspects to improve the management of attention-seeking and on the nose-work, reinforced learned attention-seeking, a behavior that may occur when a dog is deliberately or accidentally reinforced by owners for displaying certain behaviors (Gruen & Sherman, 2012). The protocol with general thunderstorm sound effects was abandoned because the owners were not able to manage it correctly and for prolonged periods of time, but a protocol of habituation to a generic non-antistatic pressure vest was introduced because, according to Cottam et al. (2013), "safe and effective treatment for canine thunderstorm phobia" and, according to Dodman et al., (2013), "moderately therapeutic for treatment of canine thunderstorm phobia", furthermore no statistically significant difference between the StormDefender® and the placebo cape groups were reported (Dodman et al., 2013). In addition, Pekkin et al. (2016) did not find a clear therapeutic effect of using pressure vests in noise phobic dogs. However, their results indicated the pressure could reduce the acute stress reaction and speed up the recovery after stress.

Alongside the behavioral modification techniques, Adaptil Collar® (CEVA Animal Health, Libourne, France) was introduced: the synthetic dog-appeasement pheromone has been shown to decrease anxiety in several fear-related conditions (Gaultier et al., 2005; Mills et al., 2006; Sherman and Mills., 2008) including noise phobia related to fireworks (Levine et al., 2007), although evidence of its efficacy as a single agent may not be sufficiently demonstrated (Frank et al., 2010).

Finally, as regards to pharmacological therapy, despite the initial resistance of the owners to

the use of psychotropics, alprazolam as needed was prescribed: 1 mg (0.029 mg/kg) of alprazolam (Xanax®, Pfizer Inc., NY, US) PO, 1 hour prior to thunderstorms or at the first sign of thunderstorm anxiety. Alprazolam is a rapid-acting benzodiazepine with strong anxiolytic and anti-panic properties (Overall, 2002).

Follow-up

First year

In the absence of thunderstorms, the presence of two safe zones, one in the bedroom and one in the living room, positioned so that the dog could be closer to the owners, immediately limited the nocturnal awakenings and the dog's anxious symptomatology. In the presence of thunderstorms, however, despite the introduction of alprazolam, the events were less frequent but still present, both day and night. The alprazolam proved to be effective if the owners managed to intervene with a certain timeliness, but it became difficult to calm the subject if the drug was administered after the beginning of the crisis which was therefore still intense. After the first summer, the owners agreed to administer medication on an ongoing basis to prepare the dog for the next summer. As suggested from the beginning, Clomipramine (Clomicalm®, Novartis International AG, Basel, Switzerland) 40 mg (1.14 mg/kg), PO, every 12 hours was introduced before the summer. Clomipramine, a tricyclic antidepressant with anxiolytic properties, is administered 1 or 2 times daily and induces a condition of continuous control of anxiety in many dogs (Overall, 2002).

Second year

The owners reported that they started allowing the dog onto the bed with them, so the pet carrier was removed because it was not used anymore. During the day, the patient used the carrier in the living room or sought contact with the owners who managed the situation correctly. During the night, she rarely got out of bed panting and asking to go outside the house. In the presence of medium-intensity thunderstorms, behavioral manifestations were reduced to trembling only and symptoms of anxiety in response to a change in barometric pressure had almost disappeared. Indeed, storm phobia is not an all-or-none phenomenon. "A certain degree of fear when exposed to a tornado, hurricane, or severe, thunderstorm is probably a normal behavioral and physiologic response, while intense fear in response to a change in a barometric pressure is not" (Crowell-Davis, 2003).

Conclusions

Owner unwillingness to use medication may pose a major limitation to the successful outcome of treatment. As a matter of fact, the dog in question has gradually improved and if medication had been given at the beginning, improvements would have been quicker. When introducing a pharmacological therapy, it is important not to forget that behavioral modification is just as crucial. In the case having the opportunity to allow the dog to sleep in the bedroom had a huge impact on behavior. In these cases, a certain degree of fear will probably always be present but the aim of treatment of the thunderstorm phobia cannot be the total elimination of the problem and owners need to be made aware of this. Furthermore, every desensitization process may encounter resensitization if the stimulus exceeds the subject's tolerance.

Finally, thanks to the results obtained and to meet the requests of the owners, the following year will be managed by stopping the therapy with clomipramine and keeping the alprazolam as needed. Trazodone (Trittico®, Angelini Spa, Rome, Italy) 150 mg (4.29 mg/kg), PO, every 12

hours, for those periods when the thunderstorms are very intense and are repeated a short distance, can be added. Trazodone is a serotonin 2α antagonist and reuptake inhibitor with a long history of safe use in humans to facilitate sleep and as an anxiolytic in dogs (Gruen & Sherman, 2008). Not a medication for the whole thunderstorm season but limited short-period medication.

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Un caso di fobia dei temporali in un Pastore Maremmano

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Sintesi

Un meticcio di Pastore Maremmano, femmina castrata, di 5 anni, probabilmente incrociato con un Retriever, è stato condotto in consulenza per una grave forma di fobia dei temporali e dei rumori forti. Adottato in estate, ha immediatamente presentato segni della fobia e risvegli notturni. Per questa ragione i proprietari si rivolsero ad un comportamentalista che raccomandò una modificazione comportamentale basata sulla creazione di una zona di sicurezza ed un programma di desensibilizzazione e contro condizionamento basato sull'ascolto di riproduzioni sonore di temporali.

La terapia sembrò avere effetti positivi, grazie all'inizio dell'autunno ed alla riduzione della frequenza dei temporali, ma col ritorno della primavera i sintomi ricomparvero.

Durante la seconda visita, effettuata dall'autore, furono valutati i video dei risvegli notturni e delle reazioni di panico associate ai temporali.

La diagnosi fu di fobia dei temporali e dei rumori forti, caratterizzata da sporadici attacchi di panico.

La terapia di modificazione comportamentale fu continuata ed introdotto Adaptil® collare e Alprazolam secondo necessità.

Dopo la prima estate i proprietari si dichiararono favorevoli a somministrare Clomipramina per preparare il cane per l'estate seguente.

In presenza di temporali di media intensità, le manifestazioni comportamentali erano limitate a tremori e i sintomi di ansietà legati alle variazioni barometriche erano quasi del tutto scomparsi.

Infine, grazie ai risultati ottenuti e per andare incontro alle richieste dei proprietari, nel prossimo anno la terapia con Clomipramina sarò sospesa e mantenuto solo l'Alprazolam in caso di necessità.

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