

# 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

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),  $32.0 \pm 20.3$  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,  $61.0 \pm 48.0$  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

### 1<sup>st</sup> 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.

### 2<sup>nd</sup> 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"*<sup>®</sup>

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.

### 3<sup>rd</sup> 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.

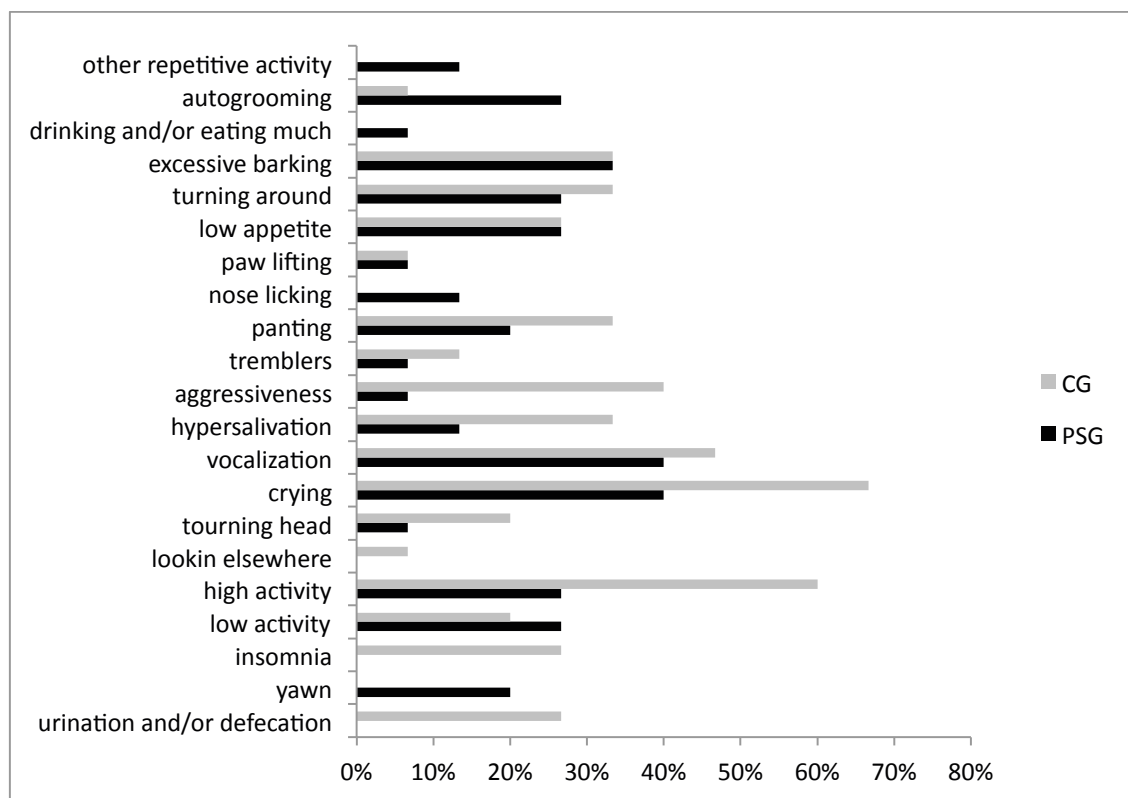


Fig. 3. Behaviors that were correctly identified as possible indicators of stress in dogs.

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 ( $W=-1.732$ ,  $p<0.083$ ).

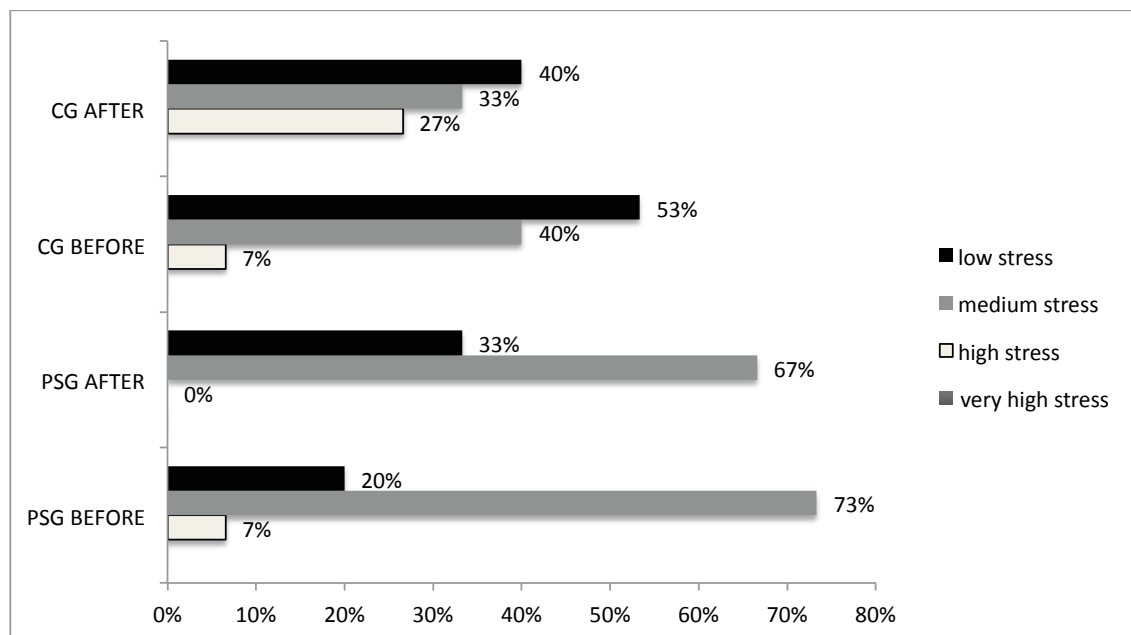


Fig. 4. Perception of stress levels in the two groups before and after the permanence in the boarding kennel.

## 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 over-stress 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 ( $36 \pm 46,16$  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  $30 \pm 41,93$  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.

