

ORIGINAL ARTICLE

Effects of Environment Enrichment on Behavioral Problems in Dogs with Separation Anxiety

Ok-Deuk Kang*

Animal Biotechnology, Jeju National University, Jeju 63243, Korea

Abstract

This study aimed to evaluate the effects of four types of environmental enrichment on the improvement of companion dogs' behavioral problems due to separation anxiety. A total of 21 dogs of various breeds were included in the study. Data were collected to investigate the behaviors associated with anxiety in dogs, including vocalization, elimination, escape attempts, and destructiveness. A first stage, in which the dog and owner were together (P0), lasted 15 min, and a second stage, in which the dog and owner were separated (P1), lasted 15 min. After the dog and owner were separated (P1), the third stage (P2), during which the environment was enriched, lasted 20 min, and the fourth stage, following environment enrichment (P3), lasted 15 min. The results of the study indicated that compared to P0, the frequency of problematic behavior was highest during the 15 min following separation from the owner (P1). Following environmental enrichment, the average frequency of problematic behaviors in P2 decreased ($P < 0.001$) compared to P1. Environmental enrichment can also be used appropriately in the case of companion dogs, including shelter dogs or experimental dogs that use a limited kennel, and is a particularly effective means of improving the quality of life of dogs.

Key words : Behavioral problems, Dog, Environment enrichment, Separation anxiety

1. Introduction

The bond between humans and dogs has a long history of development. Dogs are social animals that form strong connections with people and may consequently experience anxiety when separated from their owners. This separation anxiety can cause dogs to exhibit various problematic behaviors, creating discomfort for both dogs and their families (Pageat et al., 1995; Voith and Borchelt, 1996). Separation anxiety generally occurs when a dog is too dependent on its owner and experiences anxiety upon separation from them (Landsberg et al., 2013). Separation anxiety

is usually observed in dogs that lack socialization, whose life environment changes frequently, who experience a great deal of fear or are naturally nervous, and who have dominant relationships with their owners. Dogs with separation anxiety may exhibit problematic behaviors when they feel anxious. These behaviors typically include destructiveness (digging, chewing, and scratching), vocalization (barking, whining, and howling), elimination (urination and defecation), and escape attempts (Landsberg et al., 2013; Palestirini et al., 2010).

These inappropriate behaviors may cause distress to dog owners and their family members, often leading to

Received 14 December, 2021; **Revised** 4 January, 2022;
Accepted 4 January, 2022

***Corresponding author:** Ok-Deuk Kang, Animal Biotechnology, Jeju National University, Jeju 63243, Korea
Phone : +82-64-727-7005
E-mail : kod0816@nate.com

© The Korean Environmental Sciences Society. All rights reserved.
© This is an Open-Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

the dog being abandoned or rehomed. Behavioral problems in dogs may be attributed to various factors, including living environment, disease, heredity, and stress. Environmental enrichment (EE) may be beneficial in resolving dog behavioral problems, offering a means of improving animals' quality of life through the provision of improved living conditions (Boere, 2001) with the aim of increasing animal behavioral diversity, reducing abnormal behavior, and increasing the frequency of desired behaviors (Young, 2003). This approach is useful for reducing problematic behaviors (Carlstead & Shepherdson, 2000).

Meghan et al.(2014) reported that EE programs for shelter dogs reduce dog behavioral problems, and Sampaio et al.(2019) reported that EE methods reduce the intensity and frequency of dogs' depressive behavior. In addition, in an investigation of cortisol concentrations to monitor the stress level of dogs, it was reported that the EE program reduced cortisol concentrations (Rampim et al., 2018; Wilen et al., 2017). Positive EE results have been reported in other species, such as rabbits (Siloto et al., 2009), chimpanzees (Pullen et al., 2010), pigs (Maia et al., 2013), and fish (Xu et al., 2016).

Dogs that have been separated from their owners are generally prone to anxiety even in familiar places. Moreover, dogs are more likely to feel anxious and threatened in new locations or environments, which can exacerbate animal distress (Bradshaw et al., 2002). This study applied the EE method as a means of improving behavioral problems caused by separation anxiety and investigated whether the four aspects of EE can improve behavioral problems in companion dogs.

2. Materials and Methods

2.1. Experimental animals

A total of 21 dogs (male, castrated: 12; female, spayed: 9) with separation anxiety were selected through a brief questionnaire targeting owners who

had participated in dog training. All of the dogs lived at home as pets with their families. The questionnaire was partially revised and supplemented Hsu and Serpell's translated version (Hsu and Serpell, 2013). During experiments, the owner brought the dog and returned home after completing the experiment. This study was approved by the Institutional Animal Care and Use Committee of the Jeju National University, South Korea (Approval No. 2020-0031).

Dogs were of various breeds (Toy poodle 3; Shih tzu 3; Pomeranian 5; Maltese 3, Shiba 1; Beagle 1, Mixed 4; American cocker spaniel 1). Their average age was 3.62 ± 0.97 years, and their average weight was 6.14 ± 3.51 kg.

The key selection criterion applied in recruiting subjects for this study was that the dog exhibited typical behaviors of separation anxiety (destructiveness /digging, chewing, scratching, vocalization/barking, whining, howling, elimination/urination, defecation, and escape attempts) (Palestrini et al., 2010; Landsberg et al., 2013). Dogs with severe aggression or excessive vigilance against outsiders were excluded because they were judged to have difficulty participating in the study.

2.2. Experimental procedure

Each experimental site (6 m × 3.0 m) was equipped with a pet bed (91 cm × 76 cm) and dog kennel. A rug or cushion, which was normally used at home, was placed inside the kennel. Video footage was captured using a HER-Q800QHDS (3TB) model camera. All dogs and owners attended the test site for three days of experimentation and spend time together (30 min a day) to enable the dogs to become accustomed to the unfamiliar place.

In step 1 (P0), the dog and its owner spent 15 min together, during which time the owner restricted their interaction with the dog by looking at their cell phone or reading a book. The owner subsequently left without any greeting. In step 2 (P1), after the dog was

Step 1	Step 2	Step 3	Step 4
15min	15min	20min	15min
Dog and owner together	- Separate dog and owner - Dog and experimental researcher	<Environment enrichment> - Dog and experimental researcher	- Dog and experimental researcher
← P0 →	← P1 →	← P2 →	← P3 →

Fig. 1. Experiment design.

separated from its owner, the researcher sat where the owner had been for 15 min and did nothing to interact with the dog, again reading a book or newspaper, or looking at their cell phone. In step 3 (P2), the dog was provided with an EE (a toy with several snacks) for 20 min, after which all reinforcements were removed (the researcher opened the container and provided any remaining snacks to the dog). Step 4 (P3) was identical to step 2 (Fig. 1).

The EE method used in the study was as follows: 1) boiled pork liver (Figure 2A) was cut into small pieces, dried, and placed in a circular plastic container that emitted a "beep" sound (when rolled with the dog's paw or head, the container dispensed a snack). 2) A tennis ball (Fig. 2B) was cut in half and placed on a dry drumstick (the dog could eat the drumstick while holding it with his feet). 3) A hole (Fig. 2C) was cut into an elongated plastic container. After food was placed in the container, it was hung from an iron bar (when the dog nudged the container with his paws, the food fell). 4) A snack (Fig. 2D) was packed into a paper box (the dog could smell the box contents and opened it to eat the snack). The dogs were provided with these four types of environmental reinforcements.

2.3. Data analysis

Data collection was performed by observing the dog and its owner for the 15 min they remained together (P0), for the 15 min after the dog and its owner were

separated (P1), for the 20 min during which the EE was provided (P2), and for the 15 min after the EE had been provided (P3). The frequency with which the dog engaged in problematic behavior was scored on a five-point scale: no points (0), one point (one to three times), two points (four to six times), three points (seven to nine times), and four points (ten times or more). Video analysis was performed and recorded by two professional trainers.

SPSS 18.0 statistical program (v.21.0, SPSS, USA) was used for data analysis. One-way analysis of variance (ANOVA) was used to verify differences in dependent variables over time. The Duncan method test was conducted, and the significance level was set at $P < 0.05$.

3. Results

The results of changes in the frequency of behavioral problems are shown in Table 1. Various stress-related problematic behaviors were found to be most frequent in P1, that is during the 15 min following the dog's separation from its owner (Table 1, Fig. 3). Furthermore, the average frequency of problematic behaviors in P2 and P3 after EE was significantly lower than that in P1 ($P < 0.001$). In particular, vocalization declined by 43%; signs of distress by 38%; destructiveness by 24%; and elimination by 24% (Table 1). Although not shown in the table, 19% of

Table 1. Effect of environmental enrichment on the behavioral problems in dogs

Items	P0	P1	P2	P3
Destructiveness digging/chewing/scratching	0 (0 %)	17 (81 %)	12 (57 %)	12 (57 %)
Vocalization barking/whining/howling	2 (10%)	18 (86%)	10 (48%)	9 (43%)
Elimination urination/defecation	4 (19%)	13 (62%)	6 (29%)	8 (38%)
Escape attempts	9 (43%)	19 (90%)	10 (48%)	11 (52%)

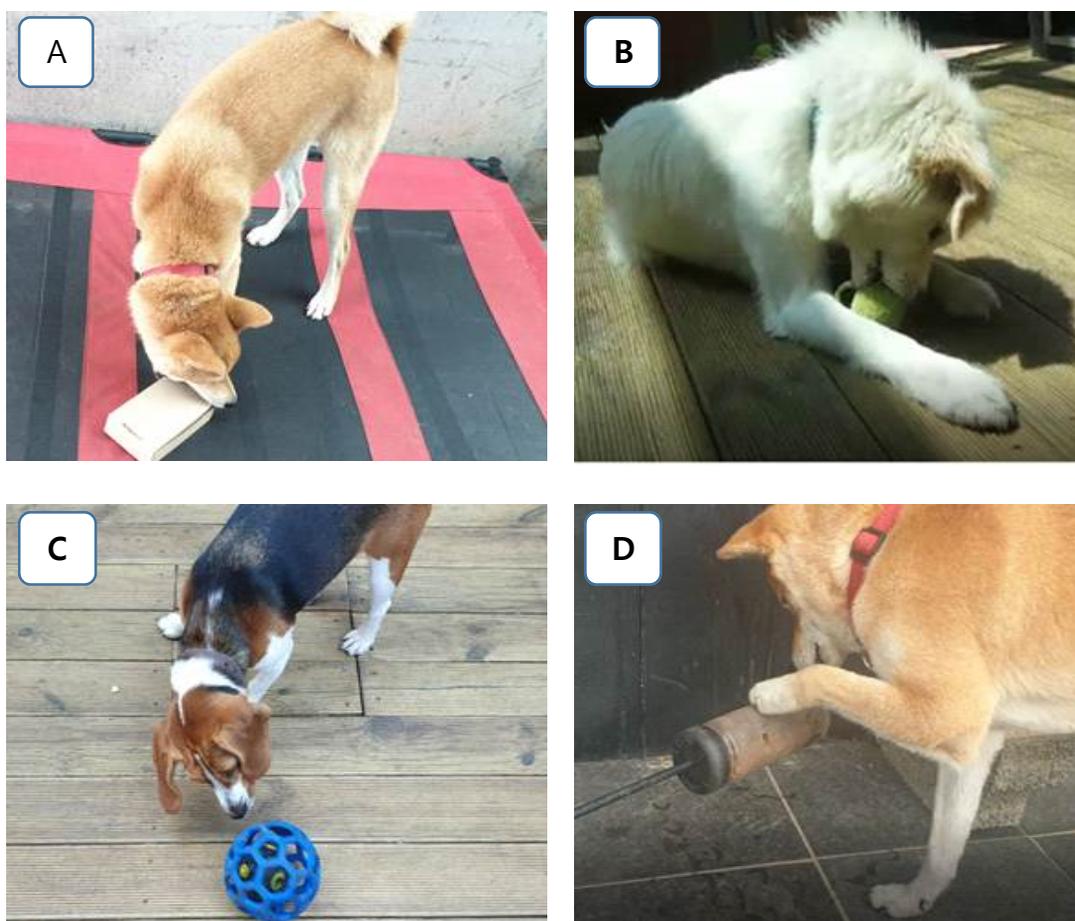


Fig. 2. 4 types of environmental enrichment for dogs with Separation Anxiety. A) A snack was packed in a paper box. B) A tennis ball was cut in half and put in a dry drumstick. C) Boiled pork liver was cut into small pieces, dried, and placed in a circular plastic container that emitted a “beep” sound. D) A hole was cut in an elongated plastic container. After the food was placed in the container, it was hung from an iron bar.

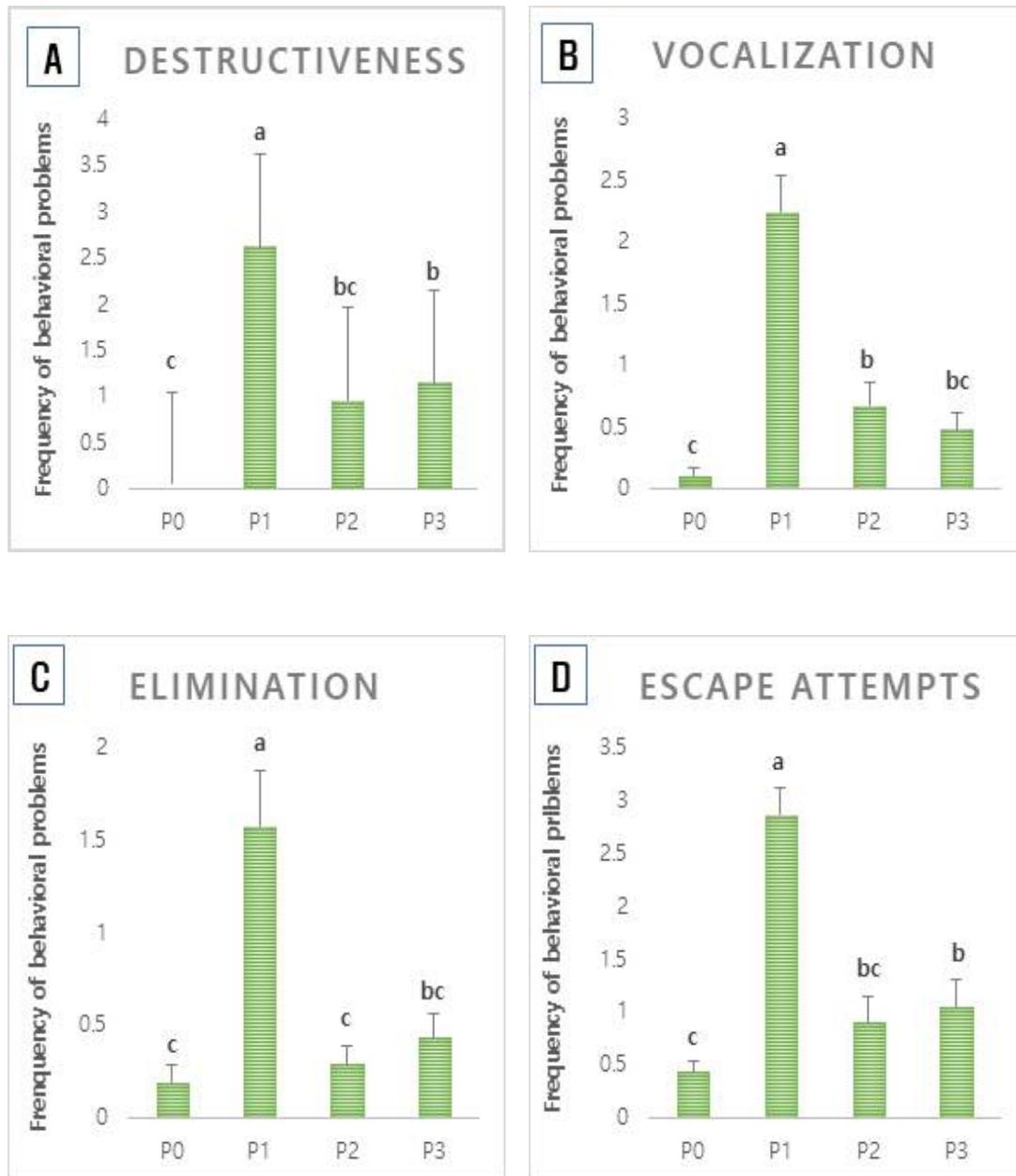


Fig 3. Changes in the frequency of behavioral problems related to separation anxiety in dogs. A: Change in the total frequency (indicator score) of destructiveness behavior problems. B) Change in the total frequency (indicator score) of vocalization behavior problems. C: Change in the total frequency (Indicator score) of elimination behavior problems. D: Change in the total frequency (Indicator score) of escape attempts behavior problems. a-c Means with different superscripts in the same row significantly differ ($p < 0.05$).

dogs showed no separation anxiety at P3 or exhibited < one problematic behavior.

In the case of destructiveness (Table 1 and Fig. 3A), this type of behavior was not observed prior to separation from the owner. During P1, 81% of dogs exhibited destructive behavior with a frequency of 2.62 ± 1.56 , which represented a significant increase ($P < 0.001$). After EE, destructive behaviors in P2 decreased by 24% compared to P1, and the frequency of such behaviors decreased significantly to 0.95 ± 1.02 ($P < 0.001$). After EE, destructive behavior in P3 was slightly higher than in P2, but the difference was not significant. Compared to P1, which had the highest frequency of destructive behavior, P3 (during the 15 min after the environment had been enriched) showed a decrease in the frequency of such behavior by 24%.

Vocalization (Table 1 and Fig. 3B) data indicated two dogs (10%) barking prior to separation from their owners. In P1, vocalization increased by 86% compared to P0, and the frequency of such behavior was 2.24 ± 1.34 , representing a significant increase from P0 ($P < 0.001$). After EE, barking in P2 decreased by 38% compared with P1, and the frequency decreased significantly to 0.67 ± 0.86 ($P < 0.001$). Compared to P1, which showed the highest frequency of vocalization, P3 showed a decrease in the frequency of such behavior by 43%.

Regarding elimination (Table 1 and Fig. 3C), four dogs (approximately 19%) exhibited this type of behavior prior to separation from their owners. In P1, 62% of dogs showed elimination-type of behavior, and the frequency was 1.57 ± 1.36 , which was significantly higher than that in P0 ($P < 0.001$). Following the provision of EE, P2 elimination decreased by 33% compared to P1, and the frequency was 0.29 ± 0.46 , representing a significant reduction ($P < 0.001$). After EE, elimination-type of behavior in P3 increased slightly compared to that in P2, but no statistically significant difference was noted. Compared with P1, which showed the highest frequency of elimination,

elimination was found to decrease by 24% in P3 (for 15 min after the environment had been enriched). Regarding escape attempts (Table 1 and Fig. 3D), nine dogs (approximately 43%) tried escaping prior to separation from their owners. In P1, 90% of dogs tried escaping with a frequency of 2.86 ± 1.20 , which was significantly higher than that in P0 ($P < 0.001$). Following EE, it was 42% lower in P2 than in P1, and the frequency in P2 was 0.90 ± 1.09 , representing a significant reduction compared to P1 ($P < 0.001$). Furthermore, compared to P1, which showed the highest frequency of escape attempts, the frequency decreased by 38% in P3.

4. Discussion

This study was conducted to evaluate the effects of EE on problematic behaviors associated with separation anxiety in dogs. EE is an effective means of improving the quality of life of animals, providing improved living conditions (Boere, 2001), and reducing the frequency of problematic behaviors by increasing behavioral diversity (Tarou and Bashaw, 2007). The dogs in this study exhibited problematic behaviors associated with separation anxiety to varying degrees. Dogs' anxiety behaviors were also diverse owing to differences in their individual living conditions (including owner attitudes). During P0, despite the presence of owners, approximately 70% of dogs exhibited behaviors associated with separation anxiety (vocalization, 2%; elimination, 19%; escape attempts, 43%). Three days before experiments commenced, the owners were asked to refrain from speaking to their dogs, making eye contact, or touching their dogs. At P0, during which time the dogs remained with their owners, the owners again did not speak to their dogs, refrained from engaging in skinship, and affected indifference. The dog and owner shared the same space, and the owner was asked to look at their cell phone or read books or newspapers. Excessive

affection on the owner's part was identified as a factor that could potentially have caused the dog to become more anxious, so the intention was to minimize this possibility. If the dogs were accustomed to sleeping in the owner's arms, the ability to rest in its owner's arms would have provided a safe environment. If the dog liked to sit on the owner's lap or enjoyed affection from its owner, it would have represented a comfortable haven. Aggression in dogs often arises from fear. When dogs are frightened, some dogs will back away, but others will show aggressive behavior (Debra Horwitz, 2021). Therefore, appropriate measures are required to alleviate fear and reduce canine aggression.

In this study, the dog and the owner were separated for 15 min (P1), during which time problematic behaviors increased (destructiveness by 81%, vocalization 76%, elimination 9%, and escape attempts 47%) in relation to P0. This is likely to have resulted from anxiety of staying in a new experimental place, rather than the dog's usual home. However, on provision on EE, the frequency of problematic behaviors decreased significantly. These results support those of Herron et al. (Tarou and Bashaw, 2007) and Sampaio et al. (Sampaio et al., 2019). Excessive stress levels in dogs are linked to problematic behavior, and stress levels can be evaluated by measuring cortisol concentrations, a non-invasive method. Our findings are consistent with those of previous studies that reported a decline in cortisol concentrations in response to EE.

When a dog is repeatedly offered the same toy during play, habituation occurs, which reduces the dog's interaction with the object. Therefore, it is particularly important to periodically exchange objects during EE (Wells 2004). Toys containing snacks can stimulate dogs' behavioral reactions by arousing their sense of smell.

In a study by Sampaio et al. (Sampaio et al., 2019), toys containing snacks were reported to be a useful tool to keep dogs active, and the present study corroborates this finding. Moreover, the present study employed

various ways for the dogs to access snacks in order to give the dogs time to think and learn how to access them. However, if accessing the snack is too difficult, the dog may give up; thus, our study took into consideration the idea that the snacks provided during the EE process should be eaten within approximately 20 min. EE provision seems to have significantly reduced the frequency of problematic behaviors. However, despite demonstrating improvements in behavioral problems, this study had certain limitations. It is possible that the dog experienced anxiety as a result of being in the experimental area rather than at home. This may have influenced the frequency of behaviors associated with separation anxiety. Moreover, the study did not consider that the dog may have been tense as a result of the researcher's presence who substituted the owner's absence during the experiment.

EE prompts a decline in the intensity and frequency of depression (Sampaio et al., 2019) and a decrease in behavioral problems (Herron et al., 2014) in dogs using limited kennels. However, a companion dog living in the home has a greatly different living environment from that of shelter dogs. Shelter dogs and isolated dogs may exhibit various behavioral disorders, such as excessive licking, low posture, and sighing, as a result of the stress associated with the limited environment of kennels (Hiby et al., 2004). However, all dogs primarily act to protect their owner and thus, problematic behaviors resulting from anxiety may arise after separation from the owner. The experiments conducted in the present study are considered meaningful because the frequency of problematic behavior was significantly reduced through the use of EE in the case of companion dogs living at home.

5. Conclusions

The results of this study revealed that the frequency

of behavioral problems caused by separation anxiety in companion dogs was significantly decreased after environmental reinforcement. Thus, EE is an effective method for reducing the frequency of problematic behaviors as it increases the diversity of positive actions. It is also considered a very important factor for dogs and humans to live together happily. Therefore, EE can improve the well-being of dogs and reduce the discomfort and fear of separation anxiety.

REFERENCES

- Boere, V., 2001, Environmental enrichment for neotropical primates in captivity, *Ciência Rural*, Santa Maria, 31(3), 543-551, <http://www.scielo.br/pdf/cr/v31n3/a31v31n3.pdf>.
- Bradshaw, J. W. S., McPherson, J. A., Casey, R. A., Larter, S., 2002, Aetiology of separation-related behavior in domestic dogs, *Vet. Rec.*, 151, 43 - 46.
- Carlstead, K., Shepherdson, D., 2000, Alleviating stress in zoo animals with environmental enrichment, In: MOBERG, G.P.; MENCH, J.A. (Eds.), *The Biology of animal stress: basic principles and implications for animal welfare*, Wallingford: CABI, Cap., 16, 337-354.
- Debra Horwitz, 2021, Dog Behavior Problems - Aggression Diagnosis and Overview, <https://vcahospitals.com/know-your-pet/dog-behavior-problems-aggression-diagnosis-and-overview>.
- Herron, M. E., Kirby-Madden, T. M., Lord, L. K., 2014, Effects of environmental enrichment on the behavior of shelter dogs, *J. Am. Vet. Med. Assoc.*, 244, 687-692.
- Hiby, E. F., Rooney, N. J., Bradshaw, J. W. S., 2004, Dog training methods: their use, effectiveness and interaction with behavior and welfare, *Anim. Welf.*, 13, 63- 69.
- Hsu, Y., Serpell, J. A., 2013, Development and validation of a questionnaire for measuring behavior and temperament traits in pet dogs, *J. Am. Vet. Med. Assoc.*, 223, 1293-1300.
- Landsberg, G. M., Hunthausen, W. L., Ackerman, L., 2013, *Behaviour problems of the dog and cat*. Tradução, Edonburgh; Saunders.
- Maia, A. P. A., Sarubbi, J., Medeiros, B. B. L., Moura, D. J., 2013, Enriquecimento ambiental como medida para o bem-estar positivo de suínos (Revisão), *Revista Eletrônica em Gestão, Educação e Tecnologia Ambiental - REGET*, Santa Maria, 14(14), 2862-2877, <https://periodicos.ufsm.br/reget/article/viewFile/10746/pdf>.
- Meghan, E., Kirby-Madden, T., Lord, L. K., 2014, Effects of environmental enrichment on the behavior of shelter dogs. *American Veterinary Medical Association.*, 244(6), 687-692.
- Pageat, P., 1995, Pathologie du comportement du chien. In: *Editions du Point Veterinaire. Maisons Alfort: Cedex.*, 288-93.
- Palestrini, C., Minero, M., Cannas, S., Rossi, E., Frank, D., 2010, Video analysis of dogs with separation-related behaviors, *Applied Ani. Sci.*, 124, 61-67.
- Pullen, A. J., Merrill, R. J. N., Brandshaw, J. W. S., 2010, Preferences for toy types and presentations in kennel housed dogs, *Applied Animal Behaviour Science*, 125(34), 151-156, <http://www.sciencedirect.com/science/article/pii/S0168159110001255>.
- Rampim, L. V., Wagatsuma, J. T., Olivia, V. N. L. de, S., 2018, Effects of environmental enrichment on the behavior and concentrations of cortisol in dogs used in animal research, *Revista Científica de medicina veterinária.*, 31.
- Sampaio, R. A. G., Martins, Y. N. D., Barbosa, F. M. S., Franco, C. I. Q., 2019, Kobayashi, M. D.; Talieri, I. C. Behavioral assessment of shelter dogs submitted to different methods of environmental enrichment. *Ciência Rural*, Santa Maria, 49, 1.
- Siloto, E. V., Zeferino, C. P., Moura, A. S. A. M. T., Fernandes, S., Sarori, J. R., Siqueira, E. R., 2009, Temperatura e enriquecimento ambiental sobre o bem estar de coelhos em crescimento. *Ciência Rural*, Santa Maria, 39(2)2, 528-533.
- Tarou, L. R., Bashaw, M. J., 2007, Maximizing the effectiveness of environmental enrichment: Suggestions from the experimental analysis of behavior, *Applied Animal Behaviour Science.*, 102, 189-204.
- Voith, V. L., Borchelt, P. L., 1996, Separation anxiety in dogs. In: Voith VL, editor. *Readings in Companion Animal Behaviour*, Veterinary Learning Systems, Borchelt, Trenton: Veterinary Learning Systems, 124-39.
- Wells, D. L., 2004, A Review of environmental enrichment for kennel dogs, *Appl. Anim. Behav. Sci.*, 85, 307-317.
- Willen, R. M., Mutwill, A., MacDonald, L. J., Schiml, P. A., 2017, Hennessy, M. B. Factors determining the effects of

human interaction on the cortisol levels of shelter dogs,
Applied Animal Behaviour Science, 186, 41-48.
Xu, S., Panikker, P., Iqbal, S., Elefant, F., 2016, Tip60 HAT
Action Mediates Environmental Enrichment Induced
Cognitive Restoration, *PLoS ONE.*, 11(7), e0159623.
Young, R. J., 2003, *Environmental Enrichment for Captive*

Animals, Blackwell Science Ltd., Oxford.

• Adjunct Professor. Ok-Deuk Kang
Animal Biotechnology, Jeju National University
& Animal Resources Research Institute
kod0816@nate.com