



Comparative Studies of Emotional Behaviors of House and Stray Dogs

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approval the final manuscript.

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ABSTRACT

Background: The industry of companion animal has been growing steadily in Korea. However, alongside this rapid growth, insufficient knowledge and immature civic awareness of the responsibilities of companion animal ownership has resulted in an increase in the number of stray animals.

Aim: The aim of this study was to form a strategy for reducing the number of stray dogs and returning the existing stray dogs to human homes in the community by comparing the difference of behavioral characteristics between stray dogs and house dogs.

Methodology: A total of 36 house dogs (HD) and stray dogs (SD) were enrolled in the study. The frequencies of and differences in aggressive, anxious, fearful, and friendly behaviors were analyzed. Various stimuli were used in five sections (section 1: appearance of a human; section 2: direct touch by a human; section 3: relationship with a dog; section 4: relationship with a human; section 5: extreme stimulation arousing fear). The dogs' responses were categorized according to the aforementioned classes of

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behavior.

Results: There was no difference between HD and SD with regard to total frequency and average frequency of aggressive responses. The average frequency of trembling, panting, roaming, and total anxious behaviors was also high in sections 1 to 5 ($P=.05$). The frequency of fearful behavior was 2.4 to 15 times greater in SD than HD. In sections 1, 2, 4, and 5 ($P=.01$), the average frequency of submissive behaviors such as ears back, tail tucked in, low posture, sitting, and total fearfulness was significantly high ($P=.01$). Finally, the total frequency of friendly behaviors was similar in SD and HD; the average frequency in sections 4 and 5 ($P=.05$) was significantly greater for SD than HD.

Conclusions: The aggressive, fearful, anxious, and friendly reactions of stray dogs are relative to conditions in their environment. Stray dogs can be adopted as companion animals if their hygiene and health are cared for and if relaxation measures are implemented.

Keywords: Aggression; animal welfare; canine behavior; stray dogs.

1. INTRODUCTION

The industry of companion animal has been growing steadily in South Korea. However, alongside this rapid growth, insufficient knowledge and immature civic awareness of the responsibilities of companion animal ownership has resulted in an increase in the number of stray animals. The increasing rate of stray animals in Korea is directly proportional to that of companion animals; there were 100,899 stray animals in 2010 [1]. The most common reasons given against adoption of stray animals include the risk of disease (26.3%) or difficulty in adapting to a new home (14.9%) [2]. These reasons may be a result, in part, from absence of confidence in the operation and control of stray animal shelters and also an ignorance of the health and behavior of the stray animals themselves. Dogs seem to be the most numerous stray animals and a rehabilitation system for disease and hygiene control in animal shelters is necessary to change ideas about adopting stray animals and to reduce the number of stray animals.

The national studies on status of stray dogs were focused on disease, health and hygiene [3-8]. On the other hand, behavioral research associated with emotion of animals is difficult to find in Korea. Psychological studies to assess the behavioral responses of dogs are able to check the status of mental health such as anxiety or fear. Furthermore these are an important aspect in determining whether stray dogs could adapt successfully to a new home. Therefore behavioral approaches to studies on the emotional status of stray or house dogs have been carried out throughout the world [9-13].

The most serious problem behavior in dogs is aggression. A study of aggression in dogs used various behavioral tests to identify aggressive species or individuals [14-17]. Anxiety and fear were measured based on behavior, and corresponding physiological reactions involving body temperature and heart rate were identified [18-20]. Hennessy et al. [21] interpreted whether dogs from animal shelters were relaxed when they had positive interactions by relating responses to friendly behavior to the concentration of cortisol in the blood. Wells et al. [22] studied the effects of various environmental changes on behaviors of shelter dogs to improve the environment of animal shelters and improve the adoption experience.

Until the behaviors of stray dogs are correctly examined under a range of conditions, the important indices of behavior will remain unknown. In this study, the behaviors of domestic house dogs and stray dogs will be compared. The differences in the frequency of aggression, anxiety, fearfulness and friendly behaviors of house and stray dogs were analyzed to examine the psychological condition of stray dogs currently kept in shelters in the nation at present.

2. MATERIALS AND METHODS

2.1 Subjects

A total of 36 dogs, 18 house dogs (HD) and 18 stray dogs (SD), were used in the study. All house dogs were cared by human owners in Chungcheongbuk-do province, and were having their own territory and regular feeding. The stray dogs were selected 3 days after they were rescued from 2 local animal shelters in Gyeonggi-Do and Chungcheongbuk-do provinces, and were confirmed not to have owners. Breed of all experimental dogs were not considered. Details of all the dogs are summarized in Table 1.

2.2 Design of the Canine Behavioral Test

The object of this test was to compare and analyze the difference between the phase and degree of aggression, anxiety, fear, and friendly behaviors of house and stray dogs exposed to a strange environment. Stray dogs lacked territories, owners, and regular nutrition etc, whereas house dogs whose status was normal. Tests simulating circumstances that had a high possibility of generating these behaviors were carried out. A test space not disturbed by any external stimuli was divided into a testing area for free movement ($\varnothing=4\text{m}$) and a central testing area ($\varnothing=2\text{m}$). Each test was composed of five sections, and each section had sub-tests. The estranged environments differing a little from one another which can induce behaviors such as dominance, possessive and fear aggression or anxiety, fear, and friendly behavior were provided for each section. First, the circumstance which can be caused by the appearance of stranger was assigned to each subtest in Section 1. Various stimulations regarding direct touch by a human stranger were specified within each subtest in Section 2. The confrontations with same species (dog) and people were each devised for reaction in Section 3 and Section 4 respectively. In section 5, the fear inducing extreme stimulations were proposed within subtests by utilizing various means. Tests were conducted in the order of specific tests for each section. The designs of the test spaces and detailed content of the test are presented in Fig. 1 and Table 2.

The dogs were tested with empty stomach, before feeding. One main camera was placed in front of the test region to record behaviors. All testers except for camera recorder and tester who perform the test with an experimental dog did not show up to the experimental dog. Therefore they did not give the dog any presence. Sub-tests were completed after the test dog was given enough time to respond to the stimulus.

All testers wore gloves and arm protectors throughout each test to ensure their safety. Testers had advanced safety training so that they could remain calm during the tests. In accordance with animal welfare, safety and animal ethics, a test was stopped if the test animal was determined to be too aggressive or showed excessive fear such as severe trembling, whining, running etc. These animal tests were implemented under the approval of

the Institutional Animal Care and Use Committee of Konkuk University (IACUC No. KU 09041).

Table 1. Characteristics of experimental house dogs (n=18) and stray dogs (n=18)

	Sex		Age				Size	
	male	female	juvenile	adult	old	less than 5kg	5kg~15kg	more than 15kg
House dogs(n=18)	7	11	1	14	3	9	5	4
Stray dogs(n=18)	9	9	0	16	2	13	5	0

Table 2. Description of the behavioral tests

Section 1 (subtests 1–5): Appearance of a stranger.
Dogs were given sedatives, relief from tension.
Subtest 1 Testperson1 enters the test room and walks with the experimental dog on a leash for about 20 seconds.
Subtest 2 Testperson 2 plays with the dog or pets the dog using a gentle voice and gesture in a testing area for free movement (encouragement).
Subtest 3 Testperson2 (male) approaches the dog slowly, gives gentle commendation and holds out his hand.
Subtest 4 Testperson3 (female) rapidly approaches testperson2 and the dog with a loud voice and claps testperson2 on the back while shaking his hand.
Subtest 5 Testperson3 holds out his hand to the dog.
Section 2 (subtests 6–12): Direct touch by a human stranger.
Subtest 6 Testperson3 fixes the leash at the center of the central testing area. She pulls the leash softly while calling the dog and staring at the dog.
Subtest 7 Test person 3 holds out her hand in front of the dog's lips.
Subtest 8 Testperson3 holds the dog's muzzle and lifts chin twice.
Subtest 9 Testperson3 pats the dog's head.
Subtest 10 Testperson3 pats the dog's breast and back.
Subtest 11 Test person 3 lifts front and rear legs and touches tail.
Subtest 12 Test person 3 lifts up the dog.
Section 3 (subtests 13–14): Relationship with a stimulus dog.
Subtest 13 (Setting a hexagon fence) Test person 4 (male) approaches the test dog with a stimulus dog on the leash.
Subtest 14 Testperson4 gives the dog a feeding bowl filled with food and water. After a while, the stimulus dog approaches the dog.
Section 4 (subtests 15–17): Relationship with a human.
Subtest 15 Test person 1 quietly touches the dog's feeding bowl.
Subtest 16 If no aggression, Test person 1 pats the dog.
Subtest 17 If no aggression, a test person takes the dog's feeding bowl away.
Section 5 (subtests 18–25): Extreme stimulation arousing fear.
Subtest 18 Test person 2 (male) approaches the dog very rapidly, yells and screams, and holds out his hand to the dog.
Subtest 19 Test person 2 shouts and claps his hands loudly.
Subtest 20 Test person 2 blows a pipe or harmonica.
Subtest 21 The dog is threatened by Test person 2 with a stick.
Subtest 22 Test person3 (female) approaches the dog with low body posture, yells and screams, and holds out her hand to the dog.
Subtest 23 Test person 3 shouts and claps his hands loudly.
Subtest 24 Test person 3 blows a pipe or harmonica.
Subtest 25 The dog is threatened by Test person 3 with a stick.

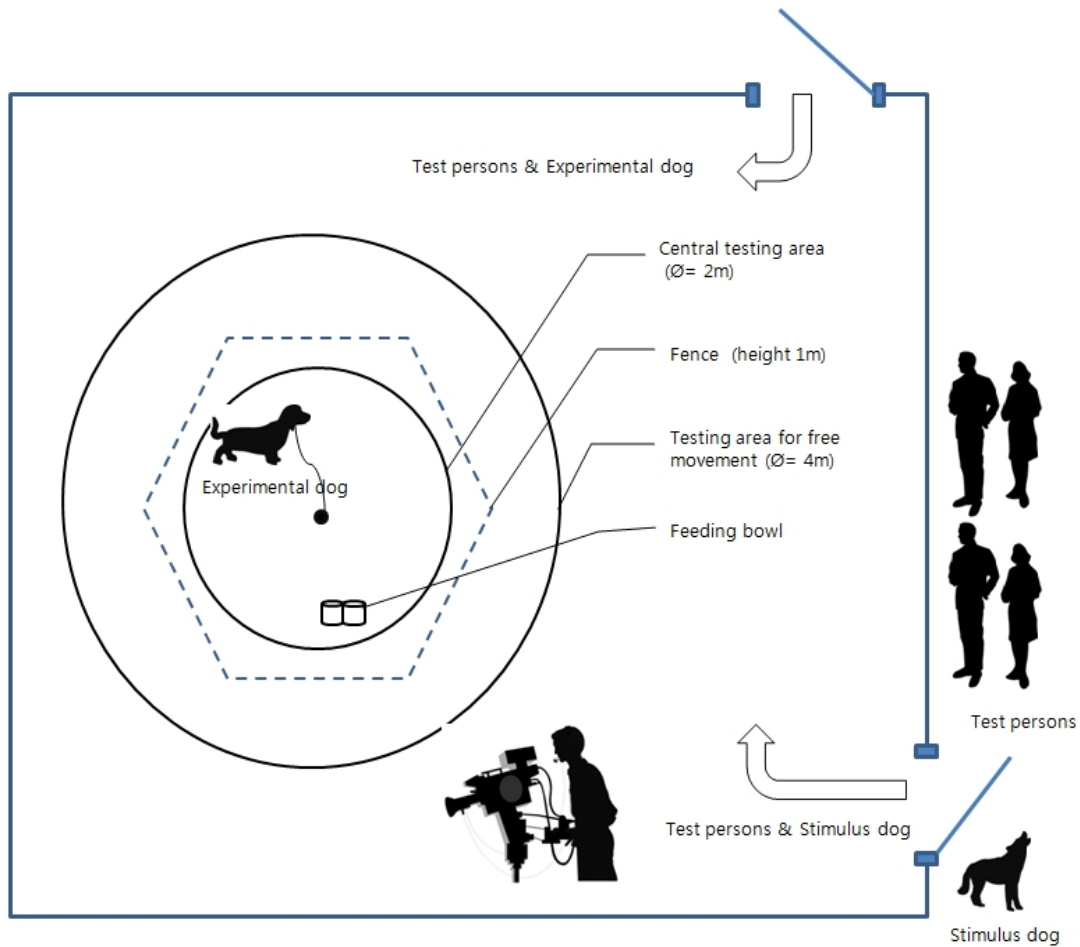


Fig. 1. Schematic view of the canine behavioral test room

2.3 Assessing the Canine Behavioral Test

Recordings of the tests were reviewed 3 times. The control group comprised HD, and the experimental group comprised SD. Analysis focused on four kinds of behavior: aggressive, anxious, fearful, and friendly. Descriptions of each kind of behavior are shown in Table 3 [13].

Table 3. Behavioral responses

Emotion	Behaviors
Aggression	Barking, growling, baring teeth, snapping, biting and chasing
Anxiety	Trembling, panting, roaming
Fear	Ears back, tail tucked in, low posture, sitting, showing belly, urinating and defecating, stepping back, shrieking, running away
Friendliness	Tail wagging, approaching, licking, leaning, jumping

2.4 Statistical Analysis

The frequency of each behavior was calculated for each section. The general linear model of the SAS program (version 9.1, SAS Institute, 2002) was used. Multiple range test and *t* test (LSD)(Duncan, 1955) were used to determine statistical significance. A P value <0.05 was considered statistically significant.

3. RESULTS

The frequency of aggressive, anxious, fearful, and friendly behaviors in SD and HD are shown in Table 4. There was no significant difference between SD and HD groups in the frequency of overall aggressive behaviors and the frequencies of other behaviors. With regard to overall aggressive behavior, both groups had a very small range. With regard to the distribution of various aggressive behaviors, HD had an even distribution of 13~27%, while in SD barking was 40% and snapping was 40%. For anxious behaviors, there were significant differences in the frequencies of trembling (P=.05), panting (P=.01), roaming (P=.05), and overall anxious behaviors (P=.01). The overall frequency of anxious behavior was about 4~16 times greater in SD than in HD. For fear, the SD group was about 2.4~15 times; the frequency of fearful behavior was greater for SD than for HD in each test. There was a significant difference in the frequency of ears back (P=.01), tail tucked in (P=.01), low posture (P=.01), sitting (P=.01), and overall fearfulness (P=.01). The rate of submissive and avoidance behaviors was different for SD and HD groups. At first, submissive behaviors such as ears back, tail tucked in, low posture, sitting, etc., were 59% in HD, and avoidance behaviors such as stepping back, shrieking, and running away were 40%. Submissive behaviors occurred at a rate of 85% in SD, and the rate of avoidance behaviors was only 15%. In friendly behaviors, any difference between house dogs and stray dogs was not detected.

The frequency of each type of behavior in HD and SD during each test section is presented in Table 5. The rate of aggressive behaviors did not differ between sections. The frequency of anxious behaviors was significantly higher in SD than in HD (P=.01). The frequency of fearful behaviors was significantly greater in SD for every section except section 3. The difference was especially significant for sections 1, 2, and 5, and for all sections combined (P=.01). The frequency of friendly behaviors was significantly greater in SD compared to HD for section 4 (P=.05) and section 5 (P=.05).

Table 4. Frequency of aggression, anxiety, fear, and friendliness in house dogs (n=18) and stray dogs (n=18)

Behavior		House dogs		Stray dogs	
Aggression	Barking	0.89	± 1.88	0.22	± 0.55
	Growling	0.78	± 2.41	0.06	± 0.24
	Baring teeth	0.72	± 2.59	0.06	± 0.24
	Snapping	0.83	± 1.98	0.22	± 0.73
	Biting and chasing	0.44	± 0.92	0.06	± 0.24
	Total	3.67	± 9.03	0.61	± 1.69
Anxiety	Trembling	0.06	± 0.24 ^b	5.11	± 8.62 ^a
	Panting	1.17	± 3.82 ^b	10.28	± 12.23 ^a
	Roaming	0.28	± 0.75 ^b	3.83	± 6.58 ^a
	Total	1.5	± 3.79 ^b	19.22	± 11.91 ^a

Behavior		House dogs		Stray dogs	
Fear	Ears back	3.28	± 4.5 ^b	14.11	± 9.15 ^a
	Tail tucked in	2.22	± 3.6 ^b	15.56	± 8.51 ^a
	low posture	0.78	± 1.26 ^b	11.78	± 7.27 ^a
	Sitting	2.94	± 4.53 ^b	12.11	± 7.51 ^a
	Showing belly	0.06	± 0.24	0.22	± 0.73
	Urinating and defecating	0.11	± 0.47	0.06	± 0.24
	Stepping back	4.17	± 3	7	± 3.99
	Shrieking	0.17	± 0.38	0.28	± 0.57
	Running away	1.44	± 1.42	2.5	± 2.62
	Total	15.17	± 9.93 ^b	63.61	± 27.88 ^a
Friendliness	Tail wagging	6.78	± 7.46	10	± 9.08
	Approaching	1.22	± 1.17	2.11	± 3.1
	Licking	0.33	± 0.77	0.61	± 1.75
	Leaning	0.78	± 1.96	0.78	± 1.83
	Jumping	0.22	± 0.55	0.28	± 0.83
	Total	9.33	± 8.27	13.78	± 14.09

a,b means statistically significant difference (P=.05, .01)

Table 5. Frequency of aggression, anxiety, fear, and friendliness in house dogs (n=18) and stray dogs (n=18)

Behavior		House dogs		Stray dogs	
Aggression	Section 1	0.61	± 1.85	0.11	± 0.32
	Section 2	0.94	± 2.04	0.06	± 0.24
	Section 3	0.33	± 0.84	0.17	± 0.51
	Section 4	0.5	± 1.29	0	± 0
	Section 5	1.28	± 4.73	0.28	± 1.18
	Total	3.67	± 9.03	0.61	± 1.69
Anxiety	Section 1	0.44	± 0.86 ^b	4.61	± 2.52 ^a
	Section 2	0.61	± 1.75 ^b	5.17	± 3.76 ^a
	Section 3	0	± 0.00 ^b	1.39	± 1.09 ^a
	Section 4	0	± 0.00 ^b	2	± 1.71 ^a
	Section 5	0.44	± 1.65 ^b	6.06	± 4.05 ^a
	Total	1.5	± 3.79 ^b	19.22	± 11.9 ^a
Fear	Section 1	2.33	± 2.25 ^b	11.67	± 5.81 ^a
	Section 2	4.11	± 5.39 ^b	17.94	± 9.53 ^a
	Section 3	0.5	± 1.04	1.67	± 2.61
	Section 4	0.72	± 1.18 ^b	5.06	± 4.48 ^a
	Section 5	7.5	± 5.40 ^b	27.28	± 9.90 ^a
	Total	15.17	± 9.93 ^b	63.61	± 27.88 ^a
Friendliness	Section 1	3.67	± 2.91	3.5	± 3.67
	Section 2	2.89	± 3.32	3.67	± 5.88
	Section 3	0.61	± 0.92	1	± 0.84
	Section 4	0.67	± 1.19 ^b	1.67	± 1.57 ^a
	Section 5	1.5	± 2.57 ^b	3.94	± 3.83 ^a
	Total	9.33	± 8.27	13.78	± 14.09

a,b means statistically significant difference (P=.05,.01)

4. DISCUSSION

The total frequency and average frequency of aggressive responses to stimuli were not significantly different in HD compared with SD. This result is similar to findings of Wells et al. [13], who studied problem behavior in dogs (N=556) adopted from an animal shelter. Four weeks after adoption, aggression towards humans was 5.5% and ranked 9th of all problem behaviors. According to data from Kim [23], 95% of stray dogs rescued in 2007 were friendly and 5% were aggressive. This does not mean any difference in the frequency of aggressive house dogs and threats of injury. Many complaints about stray dogs likely stem from misunderstanding. Fatio et al. [24] of Spain analyzed 1040 cases of aggression in dogs and found a high risk of aggression in English Cocker Spaniels and Catalan Sheepdogs. As a result of investigating various cases of human injuries caused by dog biting at Deajeon of Chungnam district, attack dogs such as pitbull terrier, tosa, and etc., and most of the injuries (26%) were caused by dog attack [25]. According to studies reported in Australia, except for the main attack dogs, injuries were caused by hunting dogs such as pit bull terriers, rottweilers, and German shepherds [26]. Since extreme snapping aggression toward humans is frequently caused by genetic factors related to species, descent, or sex, extreme snapping aggression seems to have little to do with the environment of stray dogs. Moreover, Kim et al. [27] reported in comparison study of each age of patients injured by dogs where no stray dogs existed was 86% in group A whose injured place was house, showing a far higher rate than public places (14%) while public places were 57% in group B that are random sampling models for questionnaire. These results are in the same context as a study [26] from Australia that reported that 66% of children younger than 15 years were injured at a house. Although some reasons of canine aggression appear by environmental influences [28], it appears that aggression in dogs leading to injuries is caused by congenital and genetic factors rather than environmental factors such as contact with owners and other people. Differences in the type of aggression displayed by house dogs and stray dogs should be considered. House dogs exhibited the greatest frequency of aggression in subtests 3 and 16, showing fearful aggression at a stranger's sudden approach, dominance aggression, and possessive aggression in response to a human, etc. Stray dogs exhibited the greatest frequency of aggression in subtest 25, which caused fear of extreme threats from a woman. There was not much difference between SD and HD in the frequency of aggression, but house dogs displayed more dominant aggression and stray dogs displayed more fearful aggression. Therefore, defensive aggression caused by fear in stray dogs requires further study. In addition, further study of pack aggression is required. In any event, the fact that there are similar level of aggression between house and stray dogs that had no consideration for sex, age, size and breed is very important.

The cause of anxiety in this study is compared to situations encountered by stray dogs. First, most stray dogs except the minority successors in long-term re-adaptation have lost their territory. Second, stray dogs have lost a leader whom they depended on and interacted with. Third, stray dogs are captured, enter a dog shelter, and are caged in a narrow space where their activities are restricted. Since anxiety refers to being confused by restriction of instinctive behaviors and to behaviors that reflect stress [29,30], the stress of stray dogs is expected to be considerable.

Stray dogs responded to most stimuli with fearful but submissive behavior. It is considered in case of stray dogs that all kinds of experiences such as exploration with others, approach, hiding, being captured, being caged, and etc., experiencing after losing most physical and social territories succeeded to learning about fear, through which negative resignation that avoidance or escape from fear relative stimulation was not meaningful, or positive relax was

habituated by feedback reaction of submissive behaviors. On the other hand, the fact that extreme reactions such as fear-based aggression seldom occurred in stray dogs shows that the potential for aggression and injury is not as great as the public believes. Although there is potential for aggression provoked by fear, further study of stray dogs' responses to various stimuli is required.

Finally, to the frequency of friendly behavior was similar for stray dogs and house dogs. There is no difference between stray dogs and house dogs with regard to social, friendly tendencies upon interactions with humans. Normando et al. [13] reported that a group to which enhanced human interaction program was executed with stray dog as it subjects presented significantly more tail wagging time and staying time at front of pen compared to a group to which the program was not executed. In addition, the study also suggested that friendly behavior may make the animals more likely to be re-homed.

All the results of emotional behaviors adds up to the conclusion stray dogs have excellent potential for adoption as companion dogs.

It is regrettable that the sample size for this study is small. In order to promote social return program of stray dogs in the future, continuous sampling is required for not only emotional but also hygienic and nutritional circumstances confronted by stray dogs in shelter.

5. CONCLUSIONS

In order to resolve stray dog related problems, the generation of stray dogs shall be prevented in advance through pet registration system, obligation to put on leash for a day out, neutralization operation, education to promote responsibility of owner, and others. In addition, utmost effort shall be put into reducing the number of previously generated stray dogs by returning them to human homes. To that end, we examined the psychological status of stray dogs compared with house dogs. The aggressive, fearful, anxious, and friendly reactions of stray dogs are relative to conditions in their environment. Overall aggression and friendliness of stray dogs was similar to that of house dogs, and the anxiety index and fear index were high. Stray dogs can be adopted as companion animals if their hygiene and health are cared for by sanitary individual management system, vaccination, health screening and treatment, and if relaxation measures are implemented.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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