FULL PAPER *Ethology*

Behavioral Reactivity of Jindo Dogs Socialized at an Early Age Compared with Non-Socialized Dogs

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ABSTRACT. The aim of this study was to determine whether socialized Jindo puppies would show different behavioral reactivity from non-socialized puppies. Puppies (n=12), 7 weeks of age, were divided into socialized and non-socialized groups. The socialized group from the 7th until 13th week after birth was provided a socialization program, and the non-socialized group was reared in a semi-isolated environment without being exposed to the program. At 13 weeks after birth, both groups were adopted by new families and raised as a family pet until adulthood. Both groups were tested in 5 behavioral tests at 7, 9, 11, 13 and 60 weeks of age, and their behavioral responses to the tests were recorded using video cameras. The contact, fearful and playful behaviors toward each behavioral test were scored on a scale of 1 to 5 points. Using all of the score data, a principal component analysis (PCA) extracted three primary factors: 'social reactivity towards humans and a dog', 'playful reactivity towards novel stimuli and a dog' and 'fearful reactivity towards social stimuli'. The three extracted factors were compared between the socialized and non-socialized groups in each test session (weeks). Based on the results, the socialized Jindo puppies in the test session at the 9th week after birth, in contrast to the non-socialized puppies, exhibited a higher intensity of playful reactivity towards novel stimuli and a dog. However, there were no effects of the socialization program on the Jindo puppies in terms of social reactivity towards humans and a dog as well as fearful reactivity towards social stimuli.
KEY WORDS: behavioral reactivity, Jindo dog, puppy, sensitive period, socialization.

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The Jindo dog is a native Korean medium-sized spitz-type dog that originated on Jindo Island off the Korean peninsula. A pure blood line of this breed has been well preserved, and keeping of other dog breeds has been strictly prohibited on Jindo Island because the Korean government designated this breed as natural monument No. 53 in 1962 and protects it through stringent regulations. Although the Jindo dog's temperament varies with the quality of breeding and environment, it is well known that the typical Jindo dog generally gives its devotion whole-heartedly to its owner but seems to resent being touched by those it does not know and will not show affection towards a stranger [10]. For these reasons, it is believed that the dog could serve as an excellent watchdog. In fact, a survey conducted in Jindo County showed that 33% of Jindo dog owners kept their dog as a watchdog [10].

On the other hand, on Jindo Island, many breeders breed and raise the dogs in large volumes for their farmhouse income and market the breed to both foreign and domestic buyers. In addition, the breed was registered by the Federation Cynologique Internationale (FCI) and United Kennel (UK), respectively, in 2005. As it has been recognized by both the domestic and international community, some dog breeders and professional animal handlers have maintained that the Jindo dog's aggressive response to strangers and friendly response solely to their owner should be modified in order to make it more widely acceptable as a pet and companion dog in the owner's home. In addition to these concerns, it has been suggested that a socialization program at an early age would make them well-behaved dogs with strangers as well as with their family.

In dogs, socialization is a learning process in which the puppy learns to recognize the members of its own species and members of other species [17]. The socialization period, which begins about 4 weeks of age and lasts until approximately 10 to 12 weeks of age, is a sensitive period of behavioral development and has often been referred to as the "critical period" for formation of social relationships [14, 16].

Puppies born on Jindo Island are usually for sale 7 weeks after birth, at which point they are faced with a new owner and environment. This period is approximately midpoint in the critically important time period in development of the social abilities of Jindo puppies according to current recommendations [2, 14–16]. In addition to exposing puppies to a wide range of environmental and social stimuli, it is important to avoid deficiencies in socialization with humans or development of some behavioral problems such as fears, phobias, aggressiveness and anxiety [19]. In recent years, puppy socialization programs, which introduce puppies to a variety of sounds, sights, walking surfaces, equipment and interactions with strange people and dogs in an effort to ensure adequate socialization, have become increasingly popular [2, 18].

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This study was conducted to determine whether Jindo puppies exposed to socialization programs from 7 to 13 weeks of age would show different behavioral reactivity from those not exposed to a socialization program towards their caregiver, a stranger, a strange dog and novel stimuli.

MATERIALS AND METHODS

Animals: Twelve purebred Jindo puppies from 3 litters born at the Korean Jindo dog center on Jindo Island were involved in this study. All the Jindo puppies had a veterinary examination in which no health problems were identified. The Jindo puppies had been reared by their mothers at the Korean Jindo dog center until 7 weeks of age with little human contact, except by a caregiver who visited them twice a day to feed the mothers and clean the cages. The puppies were handled according to the Laboratory Animal Control Guidelines of Gyeonsang National University, which are based on the *Guide for the Care and Use of Laboratory Animals* of the US National Institutes of Health (1996).

Study design: The puppies at 7 weeks of age were transferred from the Korean Jindo dog center to the College of Veterinary Medicine of Gyeongsang National University. After transfer, they were separated into two groups, the socialized (3 males and 3 females) and non-socialized groups (2 males and 4 females). Litters from the same dam were separated into two different groups. Two different caregivers (males) were assigned to each group, respectively.

The Jindo puppies of the socialization group were raised under laboratory conditions in which maintenance of contact with multiple individuals other than the designated caregiver was possible; the Jindo puppies of the non-socialization group were raised in a semi-isolated area located in a different room from the room in which the socialization group was raised, and maintenance of contact with multiple individuals other than the caregiver was impossible. Both groups were housed in separate wire-mesh kennels (250 × 250 × 250 cm). The puppies of the socialization group were able to see each other through sides of the kennels, but the non-socialized puppies could not. The caregivers assigned to each group, respectively, provided food and cleaned the kennels twice a day at 08:00 and 19:00 hr. The socialization group received a daily socialization program until 13 weeks of age. However, in the non-socialized group, instead of the socialization program, the names of the puppies were called out, and the puppies were patted and stroked briefly while they were eating so that they would not be completely non-socialized. In addition, all subjects of the non-socialized group were exercised by placing them together in an indoor exercise pen once a week for 10 min.

The selected socialization program was a somewhat modified form of that described in Seksel's previous studies [16, 18]. The program used in the present study did not include the training aspect of Seksel's program but did include exposure to social and novel stimuli and the handling procedures.

The order of presentation of each category of the socialization program was randomized each day. Five individuals, a male caregiver and two male and two female students of veterinary medicine, participated in the socialization program.

In order to expose the dogs to social stimuli, the caregiver stood in front of the fence, squatted facing the dog and called the dog's name once or twice in a friendly manner. The same procedure was followed by the male and female participants. Then, another dog was lead to the subjects by the caregiver and brought just before the puppy's fence, where it stood for about 10 sec. The subject was taken for a walk on a leash once (at approximately 10:00 or 18:00 hr) a day by their caregiver or the male and female participants. Each walk was performed on the campus of the university for 15 min.

Novel auditory stimuli included tape recordings of a thunderstorm (56 sec, 95.9 dB), a vacuum cleaner (25 sec, 77.3 dB), a squeaky toy (20 sec, 82 dB) and a hairdryer (30 sec, 73.5 dB) that were played approximately 1 m away from the subjects. In addition, the puppies were exposed to novel visual stimuli including a black umbrella that was opened with a built-in automatic opening device and a green tennis ball that was rolled and bounced three times, respectively, towards the puppies from approximately 1 m away.

In regard to the handling procedure, each puppy was picked up under the chest with its hindquarters supported and placed on a table. Then, the puppy was patted on the head, and its paws and mouth were examined. The handling procedure was randomly performed by the caregiver or the male and female participants.

Behavioral testing: The puppies of both groups were exposed to 5 behavioral tests to observe their behavioral responses to testing stimuli. For the baseline, all puppies were exposed to the testing situation immediately after transfer to our research facility when they were 7 weeks of age. The puppies were then tested again at the ages of 9, 11 and 13 weeks. After the last behavioral testing at 13 weeks of age, each puppy was adopted by a different family and reared in a home environment until it reached adulthood. No information on how the puppies were reared was provided. In addition, we let the new families rear the puppies as they wished. Neither groups participated in any more socialization programs. A check of all the subjects at 60 weeks of age revealed that all the animals in both groups were being raised individually as watchdogs in the front yards of residences in rural areas. In order to observe behavioral reactivity as adults and after adoption, we subjected the dogs to the same behavioral tests at 60 weeks of age that they had undergone at an earlier age.

The selected behavioral tests and the test procedures were somewhat modified forms of those of previous studies of canine temperament tests [1, 8, 9, 11–13, 20–22]. Briefly, for the behavioral tests, a circular wire-meshed enclosure (200 × 200 × 150 cm) was placed in a test room (950 × 550 cm) that was near both group's housing space but was unfamiliar to them. The test began after a 7–10 min period of habituation to the testing room and enclosure. All puppies

were exposed to the testing stimuli individually while alone in the enclosure. For further analysis, the behaviors of the puppies in response to the stimuli were recorded using two video cameras (DSR PD-170, Sony, Tokyo, Japan), which were placed on tripods (3 m away from the subject) on either side of the subject. The cameras were set up and left on prior to the beginning of testing to allow the puppies to adapt to the new setting, including the locations of the cameras.

Six participants, the subject, two caregivers who were assigned to each group respectively, a man who was absolutely unfamiliar to all subjects, an unfamiliar male dog and a test leader, took part in the test procedures. All human participants put on white lab coats during the test to ensure the consistency of color between different individual's clothes. If a puppy urinated or defecated during the test, the test site was cleaned using water and then dried to provide a dry and consistent surface for the subsequent tests.

The order of testing was randomized within each group and each test period. In order to standardize the test situation, the test leader provided instructions to the human participants about what to do and how to act before and during each test. The subject was allowed 7–10 min between each test to overcome any remaining fear.

The behavioral tests are detailed below.

Test 1) Friendly approach of the caregiver: The caregiver entered the testing room by opening the door of the room. Then, he approached the subject in the enclosure at a normal walking speed and sat down close to the enclosure while speaking in a friendly manner to the puppy (20 sec). Then, after walking five times from left to right, within a distance of 1.5 m of the fence, the caregiver left the room at a normal walking speed.

Test 2) Friendly approach of a stranger: In the same manner as in *Test 1*, a completely unfamiliar man approached the subject in a friendly way.

Test 3) Approach of a doll: The puppy was confronted with a dressed doll making a crying sound that was attached to a long pole, representing a child of 2–3 years of age. The doll was moved towards the enclosure, stopped just before reaching it and left there for 30 sec.

Test 4) Opening an umbrella: The tester rapidly opened a black umbrella with a built-in automatic opening device regardless of the puppy's position and orientation. This procedure was performed three times at intervals of 20 sec.

Test 5) Approach with a strange adult male dog: The tester, unfamiliar to all subjects, with a strange male dog on a leash approached the subject, stopping at a distance of 0.5 m from it for 30 sec.

Video analysis and scoring of behaviors: Upon completion of all test sessions, all of the video recordings of the puppies' behavior throughout the test procedures were reviewed to analyze the behavior of the subjects in response to each test. During the analysis, 3 main types of behavior were evaluated, contact, fearful and playful behavior.

The intensity of the 3 main types of behavior was scored on a scale of 1 to 5 points (the higher the score, the more intense reactivity). In the case of contact behavior, for example, 5 points were given if the puppy approached the stimuli immediately without hesitation, wagged its tail wide and fast, whined and constantly followed the stimuli while orienting its eyes to the stimuli. In the case of fearful behavior, 5 points were given if a puppy avoided the stimulus with a fast movement or lay flat and remained stationary, trembled, held its head down, held its pinnae flat against its head, licked its lips, yelped and urinated. In the case of playful behavior, 5 points were given if the puppy showed repetitive circling, standing on its hind legs, waving its paws, animated bouncing movements, stretching its forelimb forward while sustaining a repetitive motion of lying flat and standing, lying flat with frequent twisting of its body, panting and play bark. The less the intensity of the behavior, the lower the points given.

A single rater, blind to group membership and test session and trained to rate the puppies' behavior with the scoring method, reviewed all of the videotapes and scored each behavior with the tape running at normal speed, slowed down and frame by frame. All 3 types of behavior were scored independently on each behavioral test. Only the highest score of each behavior measured during each behavior test was recorded and calculated.

Statistical analysis: Due to the repeated presentations of the same stimuli from 7 to 13 weeks in each behavioral test, it is highly possible that the subjects were habituated to the test stimuli. Therefore, habituation to the test stimuli may have influenced the results of the study. Hence, the differences in the behaviors toward stimuli presented at various testing sessions may not reflect age-dependent changes. For these reasons, in order to compare behavioral differences between the two groups depending on the rearing conditions, we did not consider the age-dependent changes of the behavior in each group but focused only on the differences of behavior scores revealed in each test session.

A principal component analysis (PCA) was conducted to extract primary factors from all of the scores of the 15 variables (3 types of behavioral measures for all 5 behavior tests). The factors were rotated using the Varimax method. For each factor, the scores of variables whose factor loading values were the highest among the factors were averaged and used as the factor score. Then, we compared the factor scores between the socialized and non-socialized groups by using multivariate analysis of variance (MANOVA) in each test session.

All video samples were re-rated by the same observer for intraobserver reliability of the scores. Also, randomly selected video samples were scored by two additional observers for interobserver reliability. We extracted primary factors from each score data using PCA. Then, the similarities between factors of the rated and re-rated score data were measured by Pearson rank-order correlations. The Pearson rank correlation coefficient results are indicated as PRCC. Also, Cronbach's alpha was calculated by using the factors extracted from the score data rated by the 3 observers.

All statistical tests were performed by use of the statisti-

cal software SPSS 14.0 (SPSS Inc., Chicago, IL, U.S.A.).

RESULTS

PCA of the behavioral scores in the behavioral tests: PCA based on the 15 variables that related to contact, fearful and playful behavior for all 5 behavioral tests yielded three primary factors with eigenvalues >1, which explained 64.4% of the total variance (Table 1). According to the rotated loadings, it seemed that the first factor was positively related to contact and playful behavior towards humans (caregiver and stranger) and contact behavior towards a strange dog, which was labeled 'social reactivity towards humans and a dog (SHD)'. The second factor was negatively related to fearful and positively related to contact and playful behavior towards novel stimuli and positively related to playful behavior towards a strange dog, which was labeled 'playful reactivity towards novel stimuli and a dog (PND)'. The third factor was positively related to fearful behavior towards humans and a dog, which was labeled 'fearful reactivity towards social stimuli (FS)'.

Reliability of measures: The intraobserver reliabilities of SHD (SPCC=0.968, $P<0.001$), PND (SPCC=0.942, $P<0.001$) and FS (SPCC=0.913, $P<0.001$) were high. Also, interobserver reliability between the three observers was high because the Cronbach alphas for SHD, PND and FS were 0.978, 0.959 and 0.865, respectively. Therefore, our data were deemed to have a reliable quality.

Behavioral differences between the socialized and non-socialized puppies: In order to interpret our results more properly and easily, we rescored the factor scores. The factor scores of SHD, PND and FS were calculated as the average value of the scores of the variables that had the highest factor loading values (in bold characters in Table 1). We compared the factor scores between the two groups of puppy.

In the test session at 7 weeks of age (baseline), there were no significant differences in SHD, PND and FS between the socialized and non-socialized puppies.

Two weeks after adoption, which was 9 weeks after birth, the MANOVA results showed that the socialized and non-socialized groups of puppies had significant differences in behavior (Wilk's Lamda $F=4.76$, $P=0.039$). We subsequently examined the three factors separately. Significantly higher PND factor scores were observed for the socialized puppies than the non-socialized puppies (mean ± SD of socialized group, 2.64 ± 0.20; non-socialized group, 2.14 ± 0.34, $t=3.13$, $P=0.011$; Fig. 1). However, there were no significant differences in SHD and FS between the two groups.

In the test sessions at 11, 13 and 60 weeks of age, no significant differences in SHD, PND and FS were observed between the two groups.

Thus, at 2 weeks after exposure to the daily socialization program, the socialized Jindo puppies, in contrast to the non-socialized puppies, exhibited higher intensity of playful reactivity towards novel stimuli (opening umbrella and approaching doll) and another dog. However, there were no effects of the socialization program on the Jindo puppies in terms of social reactivity towards humans and a dog as well as fearful reactivity towards social stimuli.

DISCUSSION

In the present study, while the Jindo puppies were reared in two different environments, socialized and non-socialized conditions from 7 to 13 weeks of age, we found differences in their behavioral reactivity towards a caregiver, stranger, strange dog and novel stimuli in the behavioral tests.

Some subjective descriptions of Jindo dog temperament have been reported, and they have indicated that dogs of this breed, as a rule, are not friendly towards strangers [10]. Many breeders expect that a puppy socialization program would make the Jindo puppies a good companion dog that exhibits more social interest in humans, especially unfamiliar men. Sociability, indexed by behaviors of friendly interactions, is generally evaluated by setting up a meeting between the dog and a stranger or a strange dog [5, 7]. According to the results of the present study, both groups of

Table 1. Results of principal component analysis of the 15 variables related to contact, fearful and playful behavior of Jindo puppies in the behavioral tests

Variables	Factor 1	Factor 2	Factor 3
Contact behavior towards caregiver	**0.79**	–0.30	–0.34
Fearful behavior towards caregiver	–0.38	–0.08	**0.78**
Playful behavior towards caregiver	**0.72**	0.11	–0.13
Contact behavior towards stranger	**0.75**	0.13	–0.16
Fearful behavior towards stranger	–0.43	–0.18	**0.72**
Playful behavior towards stranger	**0.60**	0.18	0.01
Contact behavior towards doll	0.52	**0.64**	–0.11
Fearful behavior towards doll	–0.04	**–0.65**	0.41
Playful behavior towards doll	0.60	**0.68**	–0.05
Contact behavior towards opening umbrella	0.10	**0.73**	–0.11
Fearful behavior towards opening umbrella	–0.14	**–0.84**	–0.10
Playful behavior towards opening umbrella	0.02	**0.80**	–0.06
Contact behavior towards a strange dog	**0.65**	0.13	–0.36
Fearful behavior towards a strange dog	–0.02	–0.04	**0.83**
Playful behavior towards a strange dog	0.55	**0.57**	–0.12

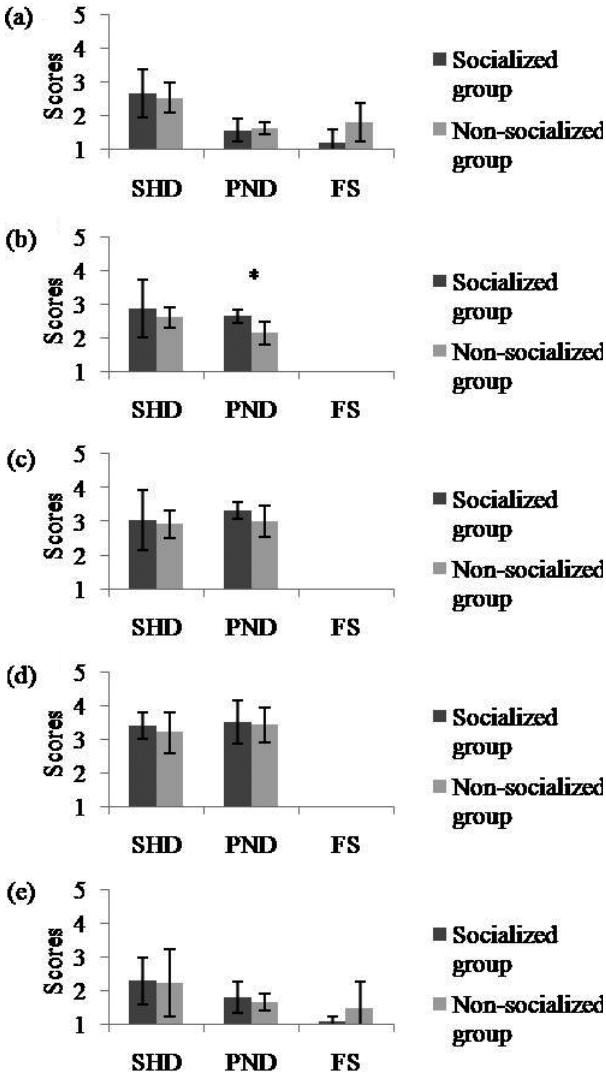

Fig. 1. Mean factor scores (± SD) of SHD, PND and FS of both groups in each test session at 7 (a), 9 (b), 11 (c), 13 (d) and 60 (e) weeks of age. *: There was a significant difference between the mean factor scores of the socialized and non-socialized puppies. MANOVA, $P<0.05$. SHD: social reactivity towards humans and a dog. PND: playful reactivity towards novel stimuli and a dog. FS: fearful reactivity towards social stimuli.

Jindo puppies showed low intensity of fearful reactivity towards social stimuli, without any significant differences. Also, the puppies showed similar intensities of social reactivity towards humans and a dog.

We believe that the reason why both groups of puppies did not express remarkably different behavioral reactivity to human stimuli was that the rearing conditions of the puppies of the non-socialized group did not include complete isolation from humans but rather included semi-isolation. A puppy reared absolutely apart from people until 12 weeks of age may later react towards them with extreme fear and hostility [4, 15]. We did not want the puppies of the non-socialized group growing up to be extremely fearful and hostile toward humans but rather puppies similar to those purchased as pets. Thus, in order to better simulate kennel and pet store conditions when designing the rearing conditions of the non-socialized puppies, we established guidelines in which the caregiver should not only provide the puppies food and clean their cages but also pat and stroke them for a moment. The puppies were removed from their mothers at 7 weeks after their birth. This age is considered a time at which puppies show a strong emotional reaction if they are separated from their mothers and littermates. Any sort of strong emotion, whether hunger, fear, pain or loneliness, will speed up the process of socialization and contribute to the strength of the social bond [14]. Moreover, puppies able to contact with people between 4 to 10 weeks of age develop social responses not only to their handler but also to other human beings. A previous study found that puppies could be successfully socialized with as little human contact as two 20-min periods per week [3, 15]. It can be suggested that, based on previous studies, in the puppies of the non-socialized group, emotional arousal may have occurred when they were separated from their mothers and littermates and brought into a new isolated environment. Despite the short period of time each day spent by the puppies of the non-socialized group with the human caregiver during feeding, their social bonds towards humans seemed to be strengthened.

For these reasons, this study suggests that the socialization program applied to the Jindo puppies adopted 7 weeks after birth had no significant effects on their social reactivity to humans in contrast to those reared in a semi-isolated environment. On the other hand, although we also did not find any behavioral differences between the two groups in the test session at 60 weeks of age, it is possible that, due to their early exposure to the program, they would have additional benefits in terms of socialization with humans during their juvenile period. However, in order to discuss this point, future studies should be pursued because this study primarily focused on conducting behavioral tests in the socialization period.

In the period of socialization, the puppy begins to express startle reactions to sounds and sudden movements, which are the first evidence of agonistic behavior. Dogs exhibit more body shaking, crouching, oral behaviors, yawning and restlessness and show a low posture when confronted with different types of stressful stimuli [1]. Also, during this period, the new capacity of the puppy to learn soon enables it to discriminate rapidly between situations that are actually dangerous and those that have no significance. As the puppy grows older, it no longer responds to irrelevant sounds and movements [15]. In the present study, we demonstrated that if Jindo puppies are exposed daily to novel stimuli that could evoke strong fearful response, the puppies would show a higher level of playful reactivity, instead of fearful reactivity, towards the same stimuli within a short period of time, 2 weeks to be specific, in contrast to the puppies unexposed to the identical stimuli. In order to demonstrate this fact, opening of an umbrella was used as the novel

stimuli evoking strong fearful response in the present study. Similarly, a previous study reported that fear of their human handlers developed remarkably in puppies at 5 weeks of age and disappeared almost completely after daily handling throughout the next two weeks [15]. In the present study, after the dogs of both groups were adopted by new families, they showed strong fearful reactivity towards opening of an umbrella in the behavioral tests conducted at 60 weeks after birth. Although fear towards stimuli decreased greatly due to repeated exposure to the novel stimuli between weeks 7 to 13, we can assume that an increased level of fearful reactivity towards the same stimuli in adulthood could be expected if the puppies are not constantly exposed as they grow to adulthood.

By 3.5 weeks of age, puppies can effectively signal that "what follows is play". The signals include the play bow in which the dog lowers its forequarters and often paws at its own face while wagging its tail, making exaggerated approaches, repeated barking, approach and withdrawal and pouncing and leaping [6]. In a similar fashion, the Jindo puppies expressed playful reactivity when a strange dog approached them. Fox and Stelzner [3] demonstrated that rearing conditions in which dogs had social experiences up to 8 weeks and subsequently were isolated from their littermates until 12 weeks of age produced no apparent deficits in the dogs' behavior towards their own kind. Similarly, the non-socialized group in the present study tended to show an almost identical level of playful reactivity towards a strange dog as the socialized group in all testing sessions, except for 2 weeks after transfer. In spite of these facts, the data of the present study demonstrated that the daily socialization program enabled the puppies to express a higher intensity of playful reactivity towards their own species within 2 weeks in contrast to the non-socialized puppies.

In conclusion, Jindo dogs have been considered a valuable asset by Korea and its people for centuries. Recently, in order to minimize their sensitivity to various stimuli and make them more sociable and friendly to people, especially unfamiliar men, many trials are being attempted to apply socialization programs starting from an early age. This study is the first report about the behavioral differences of Jindo puppies depending on their rearing conditions and should provide essential information to breeders and researchers. Based on the present study, the daily socialization program applied to the Jindo puppies from the 7th until 13th week after birth showed significant effects, not on social reactivity towards humans and a dog or fearful reactivity towards social stimuli, but on playful reactivity towards novel stimuli and a dog. However, it remains difficult to ensure that socialized puppies are better socialized. Since adequate socialization has not been well defined, assessing effective socialization may be difficult [2].

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