FULL PAPER *Ethology*

Analysis of Associations between Behavioral Traits and Four Types of Aggression in Shiba Inu

Fumihiro KANEKO[1)], Sayaka ARATA[1)], Yukari TAKEUCHI[1)]* and Yuji MORI[1)]

[1)]*Laboratory of Veterinary Ethology, Department of Animal Resource Sciences, Graduate School of Agriculture and Life Sciences, The University of Tokyo, 1–1–1 Yayoi, Bunkyo-ku, Tokyo 113–8657, Japan*

(Received 14 February 2013/Accepted 14 May 2013/Published online in J-STAGE 30 May 2013)

ABSTRACT. Canine aggression is one of the behavioral problems for which veterinary behaviorists are most frequently consulted. Despite this, the classification of canine aggression is controversial, and there are several classification methodologies. While the etiology of canine aggression differs among the types of aggression, the behavioral background underlying aggression is not well understood. Behavior trait-based evaluation of canine aggression would improve the effectiveness and efficiency of managing canine aggression problems. We developed a questionnaire addressing 14 behavioral items and items related to four types of canine aggression (owner-, child-, stranger- and dog-directed aggression) in order to examine the associations between behavioral traits and aggression in Shiba Inu. A total of 400 Shiba Inu owners recruited through dog events (n=134) and veterinary hospitals (n=266) completed the questionnaire. Factor analysis sorted the behavioral items from both the event and clinic samples into four factors: "sociability with humans," "reactivity to stimuli," "chase proneness" and "fear of sounds." While "reactivity to stimuli" correlated significantly positively with all of the four types of aggression (P=0.007 to <0.001), "sociability with humans" correlated significantly negatively with child- and stranger-directed aggression (P<0.001). These results suggest that the behavioral traits involved in canine aggression differ among the types of aggression and that specific behavioral traits are frequently simultaneously involved in several types of aggression.

KEY WORDS: aggression, behavior, canine, questionnaire.

doi: 10.1292/jvms.13-0082; *J. Vet. Med. Sci.* 75(10): 1297–1301, 2013

Canine aggression is a topic of widespread concern, as it may result in serious injuries and have significant social impact. For example, in the United States, it is estimated that more than 4.3 million people are bitten by dogs annually [7], and over 1,000 people visit hospital emergency departments for dog bites each day [6]. Canine aggression is one of the behavioral problems most frequently referred to major veterinary behavior centers at universities in the United States [1] and Spain [5], making it one of the most urgent issues confronting veterinary behavior clinics.

In order to address canine aggression, veterinary behaviorists must determine the appropriate diagnoses and treatments. However, the classification of canine aggression is controversial, and canine aggression may be classified not only according to the dog's motivation (e.g., territorial- or fear-related aggression) but also with respect to its target (e.g., stranger- or owner-directed aggression) [9]. Short consultations with owners do not always allow identification of the factors that elicit aggression. In addition, behavioral problems accompanied by aggression may involve multiple diagnoses [5], further complicating the attempts of those involved in canine behavioral problems (i.e., veterinary consultants and dog owners) to deal with them properly.

*CORRESPONDENCE TO: TAKEUCHI, Y., Laboratory of Veterinary Ethology, Graduate School of Agricultural and Life Sciences, The University of Tokyo, 1–1–1 Yayoi, Bunkyo-ku, Tokyo 113–8657, Japan.
e-mail: aytake@mail.ecc.u-tokyo.ac.jp

Dog breeds differ in their severities of aggression and propensities to behave aggressively in certain situations, i.e., aggression toward specific targets, such as owners, strangers or other dogs [4]. These breed characteristics are conserved regardless of the cultural or regional identities of the owners [14]. In addition, breeds that tend to direct aggressive behavior toward some targets do not necessarily behave aggressively toward others [4], implying that the etiologies of these aggressive behaviors differ. Determining whether certain behavioral traits are associated with specific types of aggression could increase practitioners' confidence in diagnosing canine aggression and might also facilitate treatment of the problem.

In this study, we developed a questionnaire concerning behavioral traits seen in ordinary situations that are thought to be involved in canine aggression. Elucidating the behavioral traits associated with different types of aggression may allow us to manage canine aggressive behavior more efficiently and safely. As several behaviors are reported to be associated with aggression in some way, we focused on sociability, fear and reactivity as candidate traits: sociability because it is correlated with aggression in several breeds [13], fear because it can motivate aggressive behavior in many situations, resulting in several classifications of aggression related to fear [1] and reactivity because some reactions to stimuli are associated with aggression [12]. To evaluate the association between those behavioral traits and aggression, we used the Shiba Inu, an indigenous dog breed in Japan, which has been kept as a hunting dog or a watchdog and reported to show a higher tendency to display aggression toward people and dogs relative to other breeds [14]. These

Table 1. The 18 items included in the questionnaire

Item	Description
Behavioral trait	
Sociability with men	Does the dog willingly approach unfamiliar men while out on a walk?
Sociability with women	Does the dog willingly approach unfamiliar women while out on a walk?
Sociability with children	Does the dog willingly approach unfamiliar children while out on a walk?
Fear of heavy traffic	Does the dog show any behaviors such as bending lower, flattening his/her ears, trembling, or trying to get behind in heavy traffic?
Fear of thunder	Does the dog show any behaviors such as bending lower, flattening his/her ears, trembling, or trying to get behind during thunderstorms, firework displays, or similar events?
Fear of engine noises	Does the dog show any behaviors such as bending lower, flattening his/her ears, or trying to get behind in response to sudden or loud engine noises from automobiles or motorcycles?
Chase proneness to cats	Does the dog pounce on or chase cats?
Chase proneness to birds	Does the dog pounce on or chase pigeons, crows, or other birds?
Chase proneness to other creatures	Does the dog pounce on or chase worms, lizards, frogs, or other moving small animals?
Chase proneness to falling leaves	Does the dog pounce on or chase leaves or other wind-blown objects?
Reactivity to hands	Does the dog pounce on or stare at movements such as passing by or moving hands in front of it while it is resting?
Reactivity to feet	Does the dog pounce on or stare at movements such as swinging feet under the table?
Reactivity to clattering dishes	Does the dog bark or come to investigate in response to sudden or loud noises of dishes, pans, or pots being dropped?
Reactivity to phone ringing	Does the dog bark or come to investigate when the telephone rings?
Aggression	
Owner-directed aggression	Does the dog growl aggressively at or bite household members?
Child-directed aggression	Does the dog growl aggressively at or bite children outside of the household?
Stranger-directed aggression	Does the dog growl aggressively at or bite unfamiliar men/women?
Dog-directed aggression	Does the dog growl aggressively at or bite unfamiliar dogs?

The questionnaire items are listed in the order in which they appeared on the actual questionnaire sheet. The aggression items were on a separate sheet from the behavioral trait items. The questions were answered using a frequency scale [5=always (100%), 4=often (99–61%), 3=sometimes (60–40%), 2=occasionally (39–1%), 1=never (0%)] or as "unknown." "Reactivity to feet" was excluded from the factor analysis, because of the low response rates (94.8 and 83.8% in the event and clinic samples, respectively).

characteristics, along with the ease of collecting samples in Japan, made Shiba Inu a suitable subject for the first step to search aggression-related behavioral traits in dogs.

MATERIALS AND METHODS

Development of the questionnaire: The questionnaire solicited general information (age, sexual status and housing condition) and responses concerning 14 behavioral items and four items related to aggression towards the owners, children, strangers and other dogs (Table 1). The aggression-related items were listed on a separate page from the behavioral items. Owners were asked to score their dogs' responses within the last three months using 5-point frequency scales (5=always, 4=often, 3=sometimes, 2=occasionally and 1=never) or as "unknown" (owners were instructed to answer "unknown", if the situation described in the question had not been observed or the dog's response could not be recalled clearly). The questionnaire asked about each dog's responses in situations in which social contact is made and in which fear or reactive responses can be evoked in everyday life, as proposed in the literature [8, 10] or suggested through canine behavioral practice.

Subjects: Owners of Shiba Inu were recruited through dog events organized by the Japan Kennel Club in 2008 and 2009 (event samples) and 64 veterinary hospitals mainly located around urban cities in Japan from 2009 to 2010 (clinic samples). Most of the clinic samples were collected from dog owners who visited those veterinary hospitals for canine heartworm testing. Only dogs aged 1 through 10 years were included in the analysis. A total of 400 questionnaires, including 134 event samples and 266 clinic samples, were retained. There were no significant differences in sexual status (P=0.064 by chi-squared test), housing condition (P=0.316 by chi-squared test) or age (P=0.282 by analysis of variance) between the event and clinic samples.

Data analysis: Factor analyses were performed separately on the event and clinic samples for 13 behavioral items using StatView 5J for Windows (SAS Institute, Cary, NC, U.S.A.); the questionnaire item "reactivity to feet" elicited low response rates (94.8 and 83.8% for the event and clinic samples, respectively) and was excluded from further analysis. Factor extraction was performed by the principal factor method, and the Varimax rotation was used for orthogonal transformation. The extracted factors were determined using the eigenvalue criterion (i.e., the eigenvalue for the last extracted factor was greater than 1.0). The questionnaire items for which the absolute loading on a factor was 0.4 or more were considered to belong to the factor. To assess the internal consistency of the factor, Cronbach's α reliability coefficients were calculated for the items belonging to each factor. The factor points were calculated by averaging the

Table 2. Factor loading of each questionnaire item

Questionnaire item	Event (n=106)					Clinic (n=196)			
	Sociability with humans	Chase proneness	Reactivity to stimuli	Fear of sounds		Sociability with humans	Chase proneness	Reactivity to stimuli	Fear of sounds
Sociability with women	**0.919**	0.058	–0.055	–0.015	–0.061	**0.922**	0.126	–0.022	0.018
Sociability with men	**0.912**	0.093	–0.065	–0.058	–0.065	**0.918**	0.116	–0.001	0.012
Sociability with children	**0.841**	0.077	0.048	–0.139	0.046	**0.856**	0.118	0.013	–0.071
Chase proneness to cats	–0.028	**0.834**	–0.052	0.070	–0.003	0.095	**0.826**	–0.174	0.082
Chase proneness to other creatures	0.081	**0.788**	0.130	0.144	0.190	0.091	**0.777**	0.219	–0.059
Chase proneness to birds	0.040	**0.673**	0.242	0.019	–0.311	0.102	**0.826**	0.050	–0.024
Chase proneness to falling leaves	0.324	**0.584**	0.247	–0.108	0.031	0.156	**0.641**	0.397	–0.074
Reactivity to phone ringing	0.021	0.131	**0.758**	0.279	–0.017	–0.178	0.167	**0.609**	–0.101
Reactivity to clattering dishes	–0.015	0.079	**0.750**	0.015	–0.105	0.070	0.148	**0.739**	0.160
Reactivity to hands	–0.083	0.161	**0.723**	–0.144	0.320	0.060	–0.065	**0.673**	0.172
Fear of heavy traffic	–0.040	0.060	0.045	**0.888**	–0.105	0.041	–0.113	0.221	**0.765**
Fear of engine noises	–0.234	0.085	0.098	**0.711**	0.390	–0.007	–0.063	0.202	**0.876**
Fear of thunder [a)]	–0.021	–0.016	0.039	0.068	**0.897**	–0.070	0.098	–0.160	**0.774**
Eigenvalue	2.964	2.639	1.318	1.291	1.045	1.983	3.223	1.321	2.265
Contribution ratio	22.80%	20.30%	10.10%	9.90%	8.00%	15.30%	24.80%	10.20%	17.40%
Cronbach's α	0.886	0.730	0.645	0.599	–	0.897	0.800	0.518	0.727

The items constituting each factor are shown in boldface and the numbers of dogs in parentheses. a) This item was excluded from further analysis, because of its inconsistent contribution to the factors in the two groups.

raw scores of the items constituting each factor, and their correlations with the aggression points were analyzed using Spearman's rank correlation coefficient. The Bonferroni correction [2] was applied to avoid type I error accumulation resulting from the multiple statistical analyses, resulting in a significance level of $P<0.0125$.

RESULTS

Data analysis: Factor analysis of the 13 behavioral items resulted in the extraction of five and four factors each in the event and clinic samples, respectively, which accounted for 71.1 and 67.7% of the respective common variance values (Table 2). The factor structures were identical in both samples, except for the fear-related factors; although the questionnaire items "fear of engine noises," "fear of thunder" and "fear of heavy traffic" were sorted into a single factor in the clinic samples, "fear of thunder" was separated from the other two items in the event samples. Therefore, the questionnaire item "fear of thunder" was excluded from further analysis. We named the four common factors according to the questionnaire items categorized, i.e., "sociability with humans," "chase proneness," "reactivity to stimuli" and "fear of sounds." The Cronbach's α coefficients ranged from 0.518 to 0.897 (Table 2). "Sociability with humans" and "chase proneness" exceeded the generally accepted threshold of reliability (Cronbach's $\alpha \geq 0.7$) in both samples [3]. As sexual status, housing conditions and sampling source did not significantly affect any of the behavioral factors as investigated using the 2-tailed Kruskal-Wallis H test or the Mann-Whitney U test (Table 3), these subgroup data were combined into a single group for the correlation analysis.

The coefficients of correlation between the behavioral traits and types of aggression are summarized in Table 4. While "sociability with humans" correlated significantly negatively with child- and stranger-directed aggression ($P<0.001$), "reactivity to stimuli" correlated significantly positively with all four types of aggression ($P=0.007$ to <0.001).

DISCUSSION

This study used a questionnaire to investigate the associations between four behavioral trait factors and four types of aggression in Shiba Inu. Of the four behavioral traits, "sociability with humans" correlated significantly with child- and stranger-directed aggression, whereas "reactivity to stimuli" correlated significantly with all four types of aggression. These results suggest that the behavioral traits involved in canine aggression differ among the types of aggression and that specific behavioral traits are frequently simultaneously involved in several types of aggression.

The negative correlation between "sociability with humans" and child/stranger-directed aggression is consistent with the results of a study reported by Duffy *et al.* [4], in which stranger-directed fear was shown to correlate positively with stranger-directed aggression using the Canine Behavioral Assessment and Research Questionnaire (C-BARQ) on several breeds. Svartberg [13] conducted a behavior test, the "dog mentality assessment" (DMA), on various breeds in conjunction with the C-BARQ and found sociability as measured by the DMA to correlate negatively with stranger-directed aggression as assessed by the C-BARQ. As fear aggression is a normal and instinctive behavior in dogs and the Shiba Inu has historically been used as a watchdog as well as a hunting dog [15], it seems reasonable that the less-sociable dogs are more aggressive toward unfamiliar people.

In contrast, the correlation between "reactivity to stimuli"

Table 3. Aggression scores or behavioral trait points according to sexual status, housing condition and sampling source

Sexual status					Housing condition				Sampling source		
Male	Castrated male	Female	Spayed female	*P*-value [a]	Inside	Both	Outside	*P*-value [a]	Event	Clinic	*P*-value [a]
Owner-directed aggression											
1.57 ± 0.10 (81)	1.72 ± 0.10 (72)	1.51 ± 0.09 (111)	1.52 ± 0.07 (126)	0.111	1.57 ± 0.07 (165)	1.62 ± 0.14 (39)	1.43 ± 0.10 (51)	0.482	1.65 ± 0.08 (132)	1.51 ± 0.05 (261)	0.125
Child-directed aggression											
1.46 ± 0.10 (78)	1.53 ± 0.11 (68)	1.58 ± 0.10 (109)	1.43 ± 0.08 (118)	0.598	1.44 ± 0.07 (158)	1.46 ± 0.17 (37)	1.73 ± 0.16 (51)	0.211	1.62 ± 0.09 (127)	1.43 ± 0.06 (249)	0.077
Stranger-directed aggression											
1.67 ± 0.12 (79)	1.85 ± 0.14 (71)	1.79 ± 0.11 (107)	1.54 ± 0.09 (118)	0.226	1.59 ± 0.07 (160)	1.97 ± 0.21 (37)	1.88 ± 0.17 (50)	0.145	1.78 ± 0.10 (130)	1.65 ± 0.07 (248)	0.295
Dog-directed aggression											
2.35 ± 0.14 (81)	2.26 ± 0.15 (72)	2.03 ± 0.11 (108)	2.23 ± 0.10 (124)	0.277	2.08 ± 0.09 (164)	2.61 ± 0.21 (38)	2.25 ± 0.17 (49)	0.043	2.08 ± 0.11 (132)	2.26 ± 0.07 (256)	0.061
Sociability with humans											
2.56 ± 0.12 (83)	2.25 ± 0.11 (75)	2.48 ± 0.11 (111)	2.45 ± 0.10 (127)	0.351	2.44 ± 0.08 (168)	2.32 ± 0.15 (39)	2.41 ± 0.15 (50)	0.802	2.48 ± 0.09 (133)	2.42 ± 0.07 (266)	0.569
Chase proneness											
3.08 ± 0.12 (83)	3.11 ± 0.12 (75)	3.10 ± 0.10 (112)	3.17 ± 0.09 (127)	0.910	3.05 ± 0.08 (168)	3.24 ± 0.17 (39)	3.12 ± 0.16 (51)	0.685	3.21 ± 0.09 (134)	3.07 ± 0.06 (266)	0.222
Reactivity to stimuli											
1.95 ± 0.10 (82)	1.79 ± 0.09 (75)	1.89 ± 0.08 (112)	1.88 ± 0.08 (125)	0.754	1.87 ± 0.06 (167)	1.88 ± 0.13 (39)	1.80 ± 0.11 (51)	0.811	1.99 ± 0.08 (133)	1.83 ± 0.05 (264)	0.203
Fear of sounds											
1.63 ± 0.09 (83)	1.68 ± 0.10 (74)	1.74 ± 0.09 (112)	1.88 ± 0.10 (126)	0.670	1.77 ± 0.07 (167)	1.80 ± 0.16 (38)	1.68 ± 0.13 (51)	0.479	1.78 ± 0.07 (134)	1.73 ± 0.06 (264)	0.116

Values are the mean ± SE, and the numbers of animals are shown in parentheses. a) *P*-values were calculated using the two-tailed Kruskal–Wallis H test or the Mann–Whitney U test. The level of significance was set at $P<0.05/4=0.0125$.

Table 4. Analysis of Spearman correlation between aggression and behavioral traits

	Rho	*P*-value	n
Owner-directed aggression			
Sociability with humans	0.026	0.614	392
Chase proneness	0.098	0.054	393
Reactivity to stimuli	0.217	<0.001*	391
Fear of sounds	–0.045	0.373	391
Child-directed aggression			
Sociability with humans	–0.166	0.001*	375
Chase proneness	–0.030	0.556	376
Reactivity to stimuli	0.173	0.001*	373
Fear of sounds	–0.002	0.968	375
Stranger-directed aggression			
Sociability with humans	–0.279	<0.001*	377
Chase proneness	–0.018	0.727	378
Reactivity to stimuli	0.211	<0.001*	376
Fear of sounds	0.002	0.963	377
Dog-directed aggression			
Sociability with humans	–0.122	0.017	387
Chase proneness	0.043	0.401	388
Reactivity to stimuli	0.137	0.007*	385
Fear of sounds	–0.015	0.770	386

n: The number of dogs. *The *P*-value reached the level of significance after the Bonferroni correction ($P<0.0125$).

and all four types of aggression seems to be the new information. While the different types of aggression are expected to reflect different motivations [9], retrospective studies in animal behavior practices have reported comorbidity of several types of aggression [1, 5], implying the presence of common underlying factors among the diagnostic categories of canine aggression. "Reactivity to stimuli" in this study indicates the tendency to exhibit active behavior in response to sudden movements or sounds (the specific traits constituting the factor), and it correlated positively to similar extents with all four types of aggression. One possible hypothesis is that "reactivity to stimuli" is one of the behavioral traits that predisposes to aggressive behavior and that highly reactive dogs are readier to express aggression in various situations.

The breed used in this study, the Shiba Inu, is genetically closer to wolves than are most western dogs [11], and the dog expert survey classified it as "high aggression, high reactivity and medium trainability" [14]. In behavior clinical practice, we have been often encountered Shiba Inu that show aggression triggered by sudden movement or sound. Given these characteristics of Shiba Inu, we cannot necessarily extrapolate the correlations shown in this study, especially those between "reactivity to stimuli" and the four types of aggression, to other breeds. Therefore, the questionnaire developed in this study appears to be useful for conducting similar studies with other dog breeds, and thereby to examine whether the association found between behavioral traits and aggression is common in dogs or rather specific to Shiba Inu breed. The information of behavioral traits associated with aggression would provide more accurate description of and thereby more feasible ways of treatment for each individual in various cases of aggressive behavior problems in dogs.

ACKNOWLEDGMENTS. We thank the veterinarians and the staff of their veterinary hospitals who participated in this survey for their cooperation in administering the questionnaires to the dog owners. We also appreciate the assistance of Drs. Akiko Goto and Junko Norota in conducting the questionnaire surveys. This work was supported in part by Grants-in-Aid for Scientific Research from the Ministry of Education, Culture, Sports, Science and Technology, Japan (21380172).

REFERENCES

1. Bamberger, M. and Houpt, K. A. 2006. Signalment factors, comorbidity, and trends in behavior diagnoses in dogs: 1,644 cases (1991–2001). *J. Am. Vet. Med. Assoc.* **229**: 1591–1601. [Medline] [CrossRef]
2. Bland, J. M. and Altman, D. G. 1995. Multiple significance tests: the Bonferroni method. *Br. Med. J.* **310**: 170. [Medline] [CrossRef]
3. Bland, J. M. and Altman, D. G. 1997. Statistics notes: Cronbach's alpha. *Br. Med. J.* **314**: 572. [CrossRef]
4. Duffy, D. L., Hsu, Y. and Serpell, J. A. 2008. Breed differences in canine aggression. *Appl. Anim. Behav. Sci.* **114**: 441–460. [CrossRef]
5. Fatjo, J., Amat, M., Mariotti, V. M., de la Torre, J. L. R. and Manteca, X. 2007. Analysis of 1040 cases of canine aggression in a referral practice in Spain. *J. Vet. Behav.* **2**: 158–165. [CrossRef]
6. Gilchrist, J., Gotsch, K., Annest, J. and Ryan, G. 2003. Nonfatal dog bite-related injuries treated in hospital emergency departments—United States, 2001. *Morb. Mortal. Wkly. Rep.* **52**: 605–610.
7. Gilchrist, J., Sacks, J., White, D. and Kresnow, M. 2008. Dog bites: still a problem? *Inj. Prev.* **14**: 296–301. [Medline] [CrossRef]
8. Goodloe, L. P. and Borchelt, P. L. 1998. Companion dog temperament traits. *J. Appl. Anim. Welf. Sci.* **1**: 303–338. [Medline] [CrossRef]
9. Houpt, K. A. 2006. Terminology think tank: terminology of aggressive behavior. *J. Vet. Behav.* **1**: 39–41. [CrossRef]
10. Hsu, Y. and Serpell, J. A. 2003. Development and validation of a questionnaire for measuring behavior and temperament traits in pet dogs. *J. Am. Vet. Med. Assoc.* **223**: 1293–1300. [Medline] [CrossRef]
11. Parker, H. G., Kim, L. V., Sutter, N. B., Carlson, S., Lorentzen, T. D., Malek, T. B., Johnson, G. S., DeFrance, H. B., Ostrander, E. A. and Kruglyak, L. 2004. Genetic structure of the purebred domestic dog. *Science* **304**: 1160–1164. [Medline] [CrossRef]
12. Podberscek, A. L. and Serpell, J. A. 1997. Environmental influences on the expression of aggressive behaviour in English Cocker Spaniels. *Appl. Anim. Behav. Sci.* **52**: 215–227. [CrossRef]
13. Svartberg, K. 2005. A comparison of behaviour in test and in everyday life: evidence of three consistent boldness-related personality traits in dogs. *Appl. Anim. Behav. Sci.* **91**: 103–128. [CrossRef]
14. Takeuchi, Y. and Mori, Y. 2006. A comparison of the behavioral profiles of purebred dogs in Japan to profiles of those in the United States and the United Kingdom. *J. Vet. Med. Sci.* **68**: 789–796. [Medline] [CrossRef]
15. Takeuchi, Y., Kaneko, F., Hashizume, C., Masuda, K., Ogata, N., Maki, T., Inoue-Murayama, M., Hart, B. L. and Mori, Y. 2009. Association analysis between canine behavioural traits and genetic polymorphisms in the Shiba Inu breed. *Anim. Genet.* **40**: 616–622. [Medline] [CrossRef]