

Comparison of behavioral characteristics of dogs in the United States and Japan

Miho NAGASAWA^{1,2}, Shunichi KANBAYASHI², Kazutaka MOGI², James A. SERPELL³ and Takefumi KIKUSUI²*

¹*The Department of Physiology, Jichi Medical University, 3311-1 Yakushiji, Shimotsuke, Tochigi 329-0498, Japan*

²*The Department of Animal Science and Biotechnology, Azabu University, 1-17-71 Fuchinobe, Chuo-ku, Sagamihara, Kanagawa 252-5201, Japan*

³*School of Veterinary Medicine, University of Pennsylvania, 3900 Delancey Street, Philadelphia, PA 19104-6010, U.S.A.*

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ABSTRACT. This study examined the difference in dog owning between Japan and the United States, and the effect of these differences on dogs' behavioral characteristics. Behavioral evaluations of privately-owned dogs were obtained by using online questionnaire. We compared background and demographic information from the two countries and analyzed the effects of these differences on behavioral characteristics in dogs. The results indicated that there was a bias in the dog breeds kept in Japan compared to the United States and that Japanese dogs' body weight was lower than the US dogs. The main source of dog acquisition was pet stores in Japan and breeders and/or shelters in the United States. Multiple linear regression analysis found that Japanese dogs showed more aggression to household members and higher energy, restlessness and fear of non-social stimuli than US dogs, while US dogs showed more fear of unfamiliar persons, separation-related behavior and excitability. US dogs also showed higher levels of trainability and attachment to owners. The lower dog's body weight was, the higher the behavioral scores except for trainability were. When dogs that were obtained under 3 months of age were analyzed, the younger the dogs were when their owners obtained them, the higher the scores on some behavioral problem factors were. The higher rates of problem behaviors among Japanese dogs compared with US dogs suggest that the preference for small breed dogs and poor early development environment influenced the behavioral characteristics of dogs.

KEY WORDS: behavioral characteristics, canine, C-BARQ, questionnaire

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It is estimated that there are 10,346,000 pet dogs in Japan [7]. Japanese dogs are treated as “family members” and provided with the kind of socialization and training more typical of western countries, such as the United States. On the other hand, as dogs have become increasingly integrated into human habitats, behavioral problems have also become more apparent, and these behaviors can sometimes lower the dog owners' quality of life.

In order to solve and prevent these behavior problems, evaluation methods have been developed to help understand dogs' behavioral characteristics [4, 8, 18, 21, 23]. The Canine Behavioral Assessment and Research Questionnaire (C-BARQ) is designed to provide dog owners and professionals with standardized evaluations of canine temperament and behavior [6]. The C-BARQ is also used in Japan [11, 17] after examination of the validity of questionnaire items [16].

The goal of the present study was to use C-BARQ evaluations of dogs from Japan and the United States to investigate whether cultural differences in dog ownership between the two countries influence the behavioral characteristics of their dogs. A number of general differences between

the two countries may be important for understanding variation in dog behavior. First, there are differences in the typical household living environment. Japanese homes are generally smaller than in the United States, making some particular small breed dogs more desirable in Japan. Second, the practice of dog acquisition from breeders is not yet typical among Japanese dog owners, and it is still common to acquire dogs from pet stores. A recent study in the United States has confirmed that puppies acquired from pet stores tend to display higher rates of behavioral problems as adults than those acquired from non-commercial breeders [14]. The Japanese tendency to acquire puppies from pet stores may therefore result in higher rates of undesirable behavior than in the US. In light of these differences, we hypothesized that Japanese and American dogs would display consistent differences in the prevalence of particular behavior problems.

The second goal of this study was to examine factors that influenced the behavioral characteristics in each country. It is well-established that experiences when young influence the behavioral characteristics of adults in human and nonhuman animals, including dogs [1, 2, 5, 12, 19, 25]. Therefore, we focused primarily on those factors related to experiences in youth.

MATERIALS AND METHODS

Questionnaire: Behavioral data in the present study were collected from dog owners using the C-BARQ, which includes 100 items that ask owners to indicate how their dogs have responded “in the recent past” to a variety of common

*CORRESPONDENCE TO: KIKUSUI, T., Department of Animal Science and Biotechnology, Azabu University, 1-17-71 Fuchinobe, Chuo-ku, Sagamihara, Kanagawa 252-5201, Japan.
e-mail: kikusui@azabu-u.ac.jp

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events and stimuli using a series of 0–4 rating scales (see supplemental data). The C-BARQ is a standardized questionnaire designed to assess the prevalence and severity of behavioral problems in dogs. The validation and reliability of C-BARQ have been described elsewhere [3, 6, 20]. The original C-BARQ was translated into Japanese by 2 behavioral professionals and corrected by 2 professors.

Subjects: C-BARQ data were collected via the freely accessible websites <http://www.cbarq.org> (US, from April 2006 to November 2012) and <http://cbarq.inutokurasu.jp/> (JPN, from September 2010 to November 2012). Before answering the questionnaire, dog owners were asked to provide information about their dogs, such as its breed, age, sex, neuter status, body weight, age when acquired, where acquired and the presence of any health problems. The online survey was advertised via articles in newspapers, magazines, online news and so on, in each country. The C-barq database was used for different purpose [24].

Statistical analyses: Demographic data on the dogs were analyzed by Mann-Whitney *U*-tests, χ^2 tests and Kruskal-Wallis tests (all tests were 2-tailed). If a significant difference was found in a Kruskal-Wallis test, we conducted Mann-Whitney *U*-tests for multiple comparisons, applying the Bonferroni correction.

Data from the completed questionnaires were subjected to factor analysis. Kaiser's eigenvalue rule was used to determine the number of interpretable factors that could be extracted, and varimax rotation was used to identify empirical groupings of items that measured different behavioral traits. The Cronbach's α coefficient was calculated to assess internal consistency (reliability) of extracted factors; this coefficient describes how well a group of questionnaire items focuses on a single idea or construct. For comparison of the factors, we calculated the average of item scores composing each factor, which was analyzed as a factor score. The factor scores were analyzed by multiple linear regression analysis and Mann-Whitney *U*-tests to investigate the association with the demographic characteristics of the dogs. Results are expressed as medians \pm interquartile ranges (SPSS v.19.0, SPSS Japan Inc., IBM company, Tokyo, Japan), and the results of post-hoc tests were described by the corrected *P*-values.

RESULTS

There were 5,107 C-BARQ questionnaires completed in Japan. Dogs that were <1 or >7 years of age or had severe or chronic health problems were excluded, leaving a total of 2,933 completed questionnaires (57.43%) that were considered valid. The response rates for each of the 78 items in the questionnaire ranged from 39.22 to 99.86% (median, 97.48%, mode, 98.84%). Among the 14,481 questionnaires completed in the United States, 10,500 satisfied the requirements above (72.51%). The response rates for each of the 100 items in the questionnaire ranged from 81.57% to 99.72% (median, 97.85%, mode, 98.04%). Fifteen items with response rates <85.0% either in Japanese or US data were excluded for further analyses. In each dog case, the

data of response rates <75.0% were also excluded, leaving 2,789 (54.61%) and 10,389 (71.74%) completed questionnaires that could be used in analyses in Japan and the United States, respectively.

Demographic data: There were 113 and 194 pure breeds represented, respectively, in the Japanese and US data, and there were mixed or unknown breeds in the both countries. In Japan, approximately half of all dogs belonged to the most popular 9 breeds, of which the only large breed was the Labrador Retriever. In the United States, the most popular 27 breeds accounted for 50% of all dogs (Supplementary Table 1). The median age of the dogs was 3.23 ± 1.46 years in Japan and 3.00 ± 1.50 years in the United States. There was no significant difference in the sex ratios of dogs between the 2 countries. However, the proportions of dogs that were neutered/spayed were significantly different ($\chi^2(1)=226.85$, $P<0.001$) with a greater proportion of dogs in the United States being neutered/spayed (JPN: 63.8%, US: 77.8%; $U=12467505$, $P<0.001$). The body weights of dogs in Japan were significantly lower than in the United States (JPN: 7.00 ± 3.75 kg, US: 24.00 ± 9.50 kg; $U=4911742$, $P<0.001$). The median age of dogs when acquired was also significantly lower in Japan than in the United States (JPN: 8.00 ± 8.00 weeks; US: 12.00 ± 22.00 weeks; $U=13310688$, $P<0.001$). The proportion of sources from which dogs were acquired showed significant biases in both countries. In Japan, the most common answer was "pet stores" (40.7%), and the second was "breeders" (25.3%), while "breeders" (42.4%) was first and "shelters" (33.6%) was second in the United States. This information is shown in Table 1a.

For the Factor Analysis, we selected 59 breeds that were common to both countries and then matched the samples for sex and number of dog of each breed in order to eliminate any breed or sex biases ($n=1,234$ each, Supplementary Table 1). The median ages of the dogs were not significantly different in the 2 countries, but the dogs' body weights in Japan were lower than in the United States even after standardization of the numbers and sex ratios of each breed (JPN: 8.0 ± 4.5 , US: 9.0 ± 5.5 ; $U=691119.5$, $P<0.001$). Dog's age when acquired in Japan was younger than in the United States (JPN: 10 ± 3.5 weeks, US: 12 ± 21.5 weeks; $U=591855.5$, $P<0.001$). The proportion of sources from which dogs were acquired showed the same tendencies as the analysis above in both countries (Table 1b). The median body weights of dogs were significantly different across sources of acquisition in both countries (except for "Bred by owners", "other" and "N/A"). In Japan, dogs from pet stores had significantly lower body weight than dogs from friends or relatives, breeders and shelters. In the United States, dogs acquired from breeders were significantly heavier than dogs from pet stores and shelters. The median ages of dogs when acquired were also significantly different across sources in both countries. In both countries, dogs from shelters and adopted as strays were significantly older than dogs from friends or relatives, breeders and pet stores. However, in the United States, dogs from friends or relatives were significantly older than dogs from breeders. This information is summarized in Table 2.

Factor analysis: Sixty-three of the questionnaire items

Table 1. The source from which dogs were acquired

a. All dogs

		Bred by owner	Friend or relative	Breeder	Pet store	Shelter	Stray	Other	N/A	Total
Japan	(n)	22	237	707	1,136	194	32	70	391	2,789
	(%)	0.8	8.5	25.3	40.7	7.0	1.1	2.5	14.0	100.0
The United States	(n)	519	716	4,407	308	3,488	463	488	0	10,389
	(%)	5.0	6.9	42.4	3.0	33.6	4.5	4.7	0.0	100.0
Total	(n)	541	953	5,114	1,444	3,682	495	558	391	13,178
	(%)	4.1	7.2	38.8	11.0	27.9	3.8	4.2	3.0	100.0

$\chi^2(7)=4,086.466, P<0.001.$

b. Dogs after breed- and sex-matched selection for factor analysis

		Bred by owner	Friend or relative	Breeder	Pet store	Shelter	Stray	Other	N/A	Total
Japan	(n)	6	98	389	575	32	10	30	94	1,234
	(%)	0.5	7.9	31.5	46.6	2.6	0.8	2.4	7.6	100.0
The United States	(n)	52	110	596	73	304	34	65	0	1,234
	(%)	4.2	8.9	48.3	5.9	24.6	2.8	5.3	0.0	100.0
Total	(n)	58	208	985	648	336	44	95	94	2,468
	(%)	2.4	8.4	39.9	26.3	13.6	1.8	3.8	3.8	100.0

$\chi^2(7)=713.144, P<0.001.$

Table 2. The comparison of dog's current body weight and age when acquired among the source in acquisition

	Friends or relatives	Breeders	Pet stores	Shelters	Stray	$\chi^2(4)$	P-value
Japan							
Body weight	8.00 ± 8.25 ^{a)}	9.00 ± 8.88 ^{a)}	6.00 ± 2.50 ^{b)}	9.00 ± 7.25 ^{a)}	10.50 ± 6.50	60.712	<0.01
Dog's age when acquired	10.00 ± 7.50 ^{a)}	9.00 ± 5.88 ^{a)}	11.00 ± 3.50 ^{a)}	89.00 ± 68.75 ^{b)}	116.00 ± 82.38 ^{b)}	91.008	<0.01
The United States							
Body weight	8.00 ± 7.00	10.00 ± 9.38 ^{a)}	7.00 ± 2.50 ^{b)}	8.00 ± 4.50 ^{b)}	9.00 ± 5.88	20.161	<0.01
Dog's age when acquired	12.00 ± 25.50 ^{a)}	9.00 ± 5.88 ^{b)}	10.00 ± 4.00 ^{a,b)}	78.00 ± 67.50 ^{c)}	77.00 ± 48.00 ^{c)}	392.48	<0.01

The significance probabilities are 1% except for the following comparison; Body weight: Pet stores vs. Shelters in Japan, Breeders vs. Shelters in the United States, Age when acquired: Friends or relatives vs. Stray in Japan, $P<0.05.$

common to the 2 countries were analyzed by factor analysis in each country to compare the behavioral characteristics of the 2 countries, and these items were sorted into 16 factors. After removing the items with factor loadings of <0.4 , the remaining items were analyzed by factor analysis again and yielded 12 factors that accounted for 55.47% of the common variance in item scores. Eleven factors were found to have adequate Cronbach's α values (≥ 0.7) (Table 3). The following factors were extracted: Aggression to unfamiliar persons (F1), Fear of unfamiliar persons (F2), Separation-related behavior (F3), Aggression to household members (especially resource guarding) (F4), Energy and restlessness (F5), Fear of non-social stimuli (F6), Fear of unfamiliar dogs (F7), Trainability (F8), Aggression to unfamiliar dogs (F9), Excitability (F10), Attachment and attention-seeking (F11), and Aggression to persons passing near the house (F12). These results are shown in Table 3. We compared these results with the previous study (11 factors) [16] and found that 8 factors (F2, F3, F4, F6, F7, F8, F9 and F11) were almost the same as the previous analysis. Other 2 factors in the previous

study split respectively into 2 factors (F1 and F12, and F5 and F10). The other factor in the previous study was chasing, however, the questionnaire items about chasing did not meet the criterion of response rate and were excluded in this analysis.

Multiple linear analyses of factor scores: We examined the influence of country and the various demographic variables on C-BARQ factor scores using multiple linear regression analysis. We analyzed each factor score using the following 7 explanatory variables: country, sex, spay/neuter status, owner's experience of dog-ownership, the source in acquisition of dogs, dog's age and body weight at the time of evaluation, and dog's age when acquired. Regarding the source in acquisition of dogs, the cases acquired from breeders were set as the baseline, and the standardized partial regression coefficient of each of the explanatory variable indicated the influence on the factor score compared to this baseline. In addition, we limited dog's age when acquired under 3 months of age and reanalyzed the same explanatory variables in order to investigate the influence of early experi-

Table 3. Factor loading of questionnaire items constituting each factor

Factors & questionnaire items	Factor loading	Eigenvalue	Contribution ratio	Cronbach's α
<i>Aggression to unfamiliar persons</i>		9.367	9.798	0.918
When approached directly by an unfamiliar adult while being walked or exercised on a leash	0.837			
When an unfamiliar person tries to touch or pet the dog	0.803			
When an unfamiliar person approaches the owner or a member of the owner's family away from home	0.788			
When approached directly by an unfamiliar child while being walked or exercised on a leash	0.752			
Toward unfamiliar persons visiting the home	0.713			
When an unfamiliar person approaches the owner or a member of the owner's family at home	0.664			
When mailmen or other delivery workers approach the home	0.599			
<i>Fear of unfamiliar persons</i>		4.218	5.375	0.900
When approached directly by an unfamiliar male adult while away from the home	0.823			
When an unfamiliar person tries to touch or pet the dog	0.770			
When approached directly by an unfamiliar child while away from the home	0.752			
When unfamiliar persons visit the home	0.693			
<i>Separation-related behavior</i>		3.838	5.055	0.804
Barking when left or about to be left on its owner	0.736			
Whining when left or about to be left on its owner	0.711			
Howling when left or about to be left on its owner	0.616			
Excessive salivation when left or about to be left on its owner	0.490			
Chewing/scratching at doors, floor, windows, curtains, etc.	0.476			
Loss of appetite when left or about to be left on its owner	0.405			
<i>Aggression to members of the household (especially related to possession)</i>		3.314	5.009	0.723
When food is taken away by a member of the household	0.831			
When approached directly by a member of the household while it is eating	0.772			
When a member of the household retrieves food or objects stolen by the dog	0.689			
When toys, bones or other objects are taken away by a member of the household	0.642			
When verbally corrected or punished by a member of the household	0.401			
<i>Energy and restless</i>		2.275	4.861	0.841
Playful, puppyish, boisterous	0.709			
When a member of the household returns home after a brief absence	0.685			
Active, energetic, always on the go	0.526			
When visitors arrive at its home	0.489			
Restlessness, agitation or pacing when left or about to be left on its owner	0.462			
<i>Fear of non-social stimuli</i>		2.142	4.432	0.758
In response to wind or wind-blown objects	0.699			
In response to strange or unfamiliar objects on or near the sidewalk	0.677			
In response to sudden or loud noises	0.664			
When first exposed to unfamiliar situations	0.478			
During thunderstorms	0.427			
<i>Fear of unfamiliar dogs</i>		1.887	4.114	0.883
When approached directly by an unfamiliar dog of the same or larger size	0.810			
When barked, growled or lunged at by unfamiliar dog	0.759			
When approached directly by an unfamiliar dog of a smaller size	0.755			
<i>Trainability</i>		1.734	4.028	0.800
Obeys a stay command immediately	0.769			
Obeys a sit command immediately	0.731			
Seems to attend to or listen closely to everything the owner says or does	0.622			
Returns immediately when called while off leash	0.609			
<i>Aggression to unfamiliar dogs</i>		1.537	4.026	0.897
When approached directly by an unfamiliar male dog while being walked or exercised on a leash	0.853			
When approached directly by an unfamiliar female dog while being walked or exercised on a leash	0.841			
When barked, growled or lunged at by unfamiliar dog	0.641			
<i>Excitability</i>		1.370	3.443	0.678
Just before being taken on a car trip	0.680			
Just before being taken on a walk	0.640			
When playing with you or other family member of your house	0.433			
Displays a strong attachment for one particular member of the household	0.422			
<i>Attachment and attention-seeking</i>		1.255	3.368	0.705
Tends to nudge, nuzzle or paw a member of the household for attention when that individual is sitting down	0.710			
Tends to sit close to or in contact with a member of the household when that individual is sitting down	0.656			
Tends to follow a member of household from room to room about the house	0.532			
Becomes agitated when a member of the household shows affection for another person	0.473			
<i>Aggression to persons passing near the house</i>		1.016	2.239	0.877
When strangers walk past the home while the dog is in the yard	0.662			
When joggers, cyclists, roller skaters or skateboarders pass the home while the dog is in the yard	0.599			

Table 4. The standardized partial regression coefficient of demographic variables in multiple linear regression analysis of factor scores

	F1 Aggression to unfamiliar persons		F2 Fear for unfamiliar persons		F3 Separation- related anxiety		F4 Aggression to house member	
	All	Acquired under 3 months of age	All	Acquired under 3 months of age	All	Acquired under 3 months of age	All	Acquired under 3 months of age
Country ^{a)}	-0.031	-0.043	0.127 **	0.089 **	0.249 **	0.267 **	-0.633 **	-0.655 **
Sex ^{b)}	-0.058 **	-0.072 **	0.065 **	0.039	-0.030	-0.027	-0.019	-0.020
Neutered status ^{c)}	0.031	0.014	-0.016	-0.022	0.033	0.009	0.015	0.009
Dog-ownership experience ^{d)}	-0.012	-0.020	-0.002	-0.024	-0.093 **	-0.105 **	-0.025	-0.020
The source in acquisition ^{e)}								
Bred by owner	-0.013	-0.060 *	0.003	-0.010	-0.011	-0.060 *	-0.004	-0.039
Friend or relative	0.108 **	0.135 **	-0.001	0.006	0.039	0.043	0.048 **	0.057 **
Pet store	0.058 *	0.086 **	0.023	0.052	0.040	0.053	0.057 **	0.040
Shelter	0.094 **	0.053 *	0.051 *	0.037	0.096 **	0.091 **	0.043 *	0.023
Stray	0.053 *	0.020	0.003	-0.012	0.078 **	0.047	0.038 *	0.007
Body weight	-0.160 **	-0.181 **	-0.178 **	-0.182 **	-0.148 **	-0.179 **	-0.023	-0.033
Dog's age at evaluation	0.014	0.035	-0.038	-0.028	-0.057 **	-0.040	-0.145 **	-0.137 **
Dog's age when acquired	-0.079 **	-0.104 **	0.054 *	-0.067 *	-0.032	-0.092 **	-0.056 **	-0.061 **
Adj R ²	0.046 **	0.071 **	0.063 **	0.043 **	0.112 **	0.130 **	0.461 **	0.465 **
	F5 Energy & restless		F6 Fear for non-social objects		F7 Fear for unfamiliar dogs		F8 Trainability	
	All	Acquired under 3 months of age	All	Acquired under 3 months of age	All	Acquired under 3 months of age	All	Acquired under 3 months of age
Country ^{a)}	-0.165 **	-0.187 **	-0.103 **	-0.132 **	0.007	-0.007	0.153 **	0.148 **
Sex ^{b)}	-0.082 **	-0.078 **	0.027	0.038	0.089 **	0.096 **	0.036	0.057 *
Neutered status ^{c)}	0.041 *	0.025	-0.048 *	-0.033	-0.044 *	-0.015	-0.063 **	-0.039
Dog-ownership experience ^{d)}	-0.039	-0.046	-0.045 *	-0.057 *	-0.019	-0.019	0.083 **	0.091 **
The source in acquisition ^{e)}								
Bred by owner	-0.027	-0.111 **	-0.028	-0.050	-0.014	-0.051	-0.023	-0.005
Friend or relative	0.047 *	0.021	-0.027	-0.035	-0.011	-0.011	-0.037	-0.041
Pet store	0.158 **	0.149 **	0.048	0.060 *	0.086 **	0.110 **	-0.153 **	-0.145 **
Shelter	0.059 *	0.024	-0.016	0.024	0.020	0.011	-0.063 *	-0.013
Stray	0.034	-0.004	0.017	0.002	-0.015	-0.030	-0.029	0.010
Body weight	-0.106 **	-0.144 **	-0.139 **	-0.149 **	-0.136 **	-0.154 **	0.156 **	0.164 **
Dog's age at evaluation	-0.022	-0.034	0.048 *	0.064 *	0.005	0.007	0.105 **	0.095 **
Dog's age when acquired	-0.032	-0.147 **	0.044	-0.027	-0.005	-0.057	-0.091 **	0.045
Adj R ²	0.099 **	0.127 **	0.048 **	0.063 **	0.038 **	0.052 **	0.113 **	0.107 **
	F9 Aggression to unfamiliar dogs		F10 Excitability		F11 Attachment and attention-seeking		F12 Aggression to passers around house	
	All	Acquired under 3 months of age	All	Acquired under 3 months of age	All	Acquired under 3 months of age	All	Acquired under 3 months of age
Country ^{a)}	0.035	0.039	0.255 **	0.270 **	0.395 **	0.395 **	0.077 **	0.070 *
Sex ^{b)}	-0.078 **	-0.077 **	-0.049 *	-0.037	-0.016	-0.024	-0.022	-0.022
Neutered status ^{c)}	-0.014	-0.029	0.077 **	0.080 **	0.021	0.017	0.029	0.019
Dog-ownership experience ^{d)}	-0.024	-0.020	-0.044 *	-0.029	0.017	0.021	-0.002	-0.001
The source in acquisition ^{e)}								
Bred by owner	0.007	-0.018	-0.009	-0.046	-0.041 *	-0.094 **	0.005	-0.016
Friend or relative	0.076 **	0.113 **	0.047 *	0.041	0.023	0.018	0.083 **	0.109 **
Pet store	0.029	0.072 *	0.048 *	0.046	0.036	0.016	0.045	0.053
Shelter	0.105 **	0.036	0.058 *	0.045	0.058 *	0.016	0.066 *	0.026
Stray	0.053 *	0.016	0.037	0.001	0.036	0.023	0.029	-0.010
Body weight	-0.078 **	-0.079 **	-0.053 **	-0.063 *	-0.068 **	-0.094 **	-0.133 **	-0.161 **
Dog's age at evaluation	0.115 **	0.135 **	0.012	0.027	-0.079 **	-0.061 *	0.014	0.035
Dog's age when acquired	-0.055 *	-0.072 *	-0.093 **	-0.070 *	-0.018	-0.075 **	-0.096 **	-0.048
Adj R ²	0.034 **	0.043 **	0.066 **	0.075 **	0.156 **	0.149 **	0.027 **	0.035 **

a) Japan: 0, US: 1, b) male: 0, female: 1, c) intact: 0, neutered: 1, d) first ownership: 0, second and more ownership: 1, e) Acquired from there: 1/ Not acquired from there: 0. The cases acquired from breeders are set as the baseline, and the standardized partial regression coefficient of each of the explanatory variable indicated the influence on the factor score compared to this baseline. * $P < 0.05$, ** $P < 0.01$.

ence more properly. The results are shown in Table 4. In the case that all data were included, all of the factor scores except F1, F7 and F9 were explained significantly by the variable 'country', and the standardized partial regression coefficient in F4, F5 and F6 indicated that dogs in Japan tended to display higher factor scores than dogs in the US. Sex differences explained F1, F2, F5, F7, F9 and F10, and male dogs tended to obtain higher factor scores than female dogs on F1, F5, F9 and F10. Neuter/Spay status explained F5, F6, F7, F8 and F10, and intact dogs showed higher scores on F6, F7 and F8. Previous experience of dog-owning explained F3, F6, F8 and F10, and the score of F8 was higher when owners had previous dog-owning experience. In the source in acquisition of dogs, acquisition from a shelter explained 10 factors (except for F6 and F7). The case of friend or relative and pet store explained 6 factors respectively (Friend or relative: F1, F4, F5, F9, F10 and F12, pet store: F1, F4, F5, F7, F8 and F10). These factor scores except for F8 were higher in comparison to the acquisition from breeders. Body weight explained all factors except F4, and the lower dog's body weights were, the higher their factor scores were except for F8. Age at evaluation explained F3, F4, F6, F8, F9 and F11, and older dogs obtained higher factor scores for F6, F8 and F9. Age when dogs were acquired explained F1, F2, F4, F8, F9, F10 and F12, and the younger the dogs were when their owners obtained them, the higher their scores on these factors except for F2 were. In the case of only dogs that were obtained under 3 months of age ($n=1,516$), the source in acquisition of dogs which explained the factors mostly is from pet stores (F1, F5, F6, F7, F8 and F9), of which factor scores except for F8 were higher in comparison to the acquisition from breeders. Dogs from friend or relative showed highest scores in the factors related with aggression (F1, F4, F9 and F12). Age when dogs were acquired explained the factor scores except for F6, F7, F8 and F12, and the younger the dogs were when their owners obtained them, the higher their scores on these factors were.

DISCUSSION

Using an online behavioral evaluation system, we collected data on the behavioral characteristics of dogs in Japan and the United States, and investigated differences between the 2 countries. First, we compared background and demographic information for the dogs using all valid data. The results showed that there was a bias in the dog breeds that are chosen by the owners in Japan compared to the United States, which has a wide variety in the breeds that are common; and Japanese dogs' body weights were significantly lower than those of US dogs even after standardization for the number and sexes of each breed, indicating both a Japanese preference for small-sized dogs and a tendency for US dogs to be heavier irrespective of breed and sex. From a historical perspective, most breeds were produced in Europe and the United States, while there were few breeds native to Japan; lack of diversity of breeds in Japan might bring a bias towards owning particular breeds. Japanese owners commonly acquire their dogs from pet stores, while the main

sources from which dogs were acquired in the United States were breeders and shelters. This might be due to the easy access to animal shelters as a source for acquiring dogs in the United States. The ratio of neutered dogs was higher in the United States than in Japan, suggesting a cultural difference in attitudes to surgical sterilization between the two countries. Dog's age when acquired was significantly greater in the United States than in Japan. This result may be due to the larger proportion of dogs acquired from shelters in the US sample.

After breed- and sex-matched selection for Factor Analysis, we compared the demographic information again. We found a significant difference in three parameters. First, body weight differences remained despite breed-matched selection between two countries. Second, with respect to dog's age when acquired, there was no significant difference between dogs from breeders and those from pet stores in each country. Considering the time-lag from weaning to acquisition from pet stores [15], dogs from pet stores may be taken from their litters earlier than dogs from breeders. Third, the body weight of dogs from pet stores was significantly lower than that from breeders in each country, suggesting that small breeds were acquired mainly from pet stores.

In order to investigate which demographic variables affected the dog's behavioral characteristics, we analyzed C-BARQ factor scores using multiple linear regression analysis. We found that the variable 'country' affected 9 out of 12 factors. Dogs in Japan showed the more aggression toward household members, more energy and restlessness, and more fear of non-social stimuli than dogs in the United States. On the other hand, dogs in the United States showed more fear of unfamiliar persons, more separation-related behavior and greater excitability, while showing also higher scores for trainability and attachment and attention-seeking. Further research will be needed to identify the reasons for these differences in behavior between the two countries. In all sources in acquisition of dogs except for "bred by owner", most factor scores were higher than those of breeder (except for trainability). The source in acquisition of dogs that explained the factors mostly was from pet stores when dog's age when acquired was limited under 3 months of age, although that was from shelter in the case of all data. The factor scores except for trainability of dogs from pet stores were higher than from breeders, suggesting the possibility that the early developmental experience was not appropriate in pet stores. In addition, it is notable that acquisition from friend or relative was strongly related to aggression. We found also that dog's body weight correlated with most behavioral characteristics, indicating that small breed dogs tended to display a greater potential for problem behaviors as well as reduced trainability. This finding replicates those from a previous study that found that dogs' skull shape, height and bodyweight co-vary with their behavior [13]. The standardized partial regression coefficients of other demographic variables were also significant, but very low.

We hypothesized that dog's age at time of acquisition was related to their behavioral characteristics. Multiple linear regression analysis in this study did not show a large effect

of age of acquisition on factor scores, because these data included dogs that were acquired in adulthood. Analysis which limited dogs that were acquired under 3 months of age revealed that the effect of age of acquisition on factor scores became higher than the analysis which included all dogs in most factors. This suggests that the earlier the dogs were acquired in their developmental period (that is, dogs were separated from their mother too early), the worse the dog's behavioral characteristics may be influenced. In rodent models, it has been demonstrated that the maltreatment of pups in early developmental periods, such as early weaning, influences adult temperament. We previously demonstrated that early weaning caused exposure to high levels of glucocorticoids in the central nervous system of mouse pups [9]. These can increase the stress response of pups and decrease nutritional factors in the central nervous system, leading to excessive anxiety and aggression and decreased learning capacity, among other effects [10]. From these previous studies, the current data suggested that the high fear, high aggression, high excitability and low trainability found in dogs from pet stores were related to early weaning. In addition, Slabbert and Rasa [22] found that dogs that had been separated from their mothers and nest sites (but not their littermates) at 6 weeks of age were prone to exhibit loss of appetite and weight and increased distress, mortality and susceptibility to disease compared to dogs that had remained at the nest sites with their mothers until 12 weeks of age. It can be inferred that while it is important for dogs to be exposed to human society during the early developmental period for socialization, very early mother-infant separation could cause adverse effects in dogs during adulthood.

In conclusion, the comparison of demographic data and behavioral characteristics of dogs between Japan and the United States, using an online questionnaire, showed that Japanese owners were more likely to have acquired their dogs from pet stores and had preferences for a few particular small breeds. We also found a greater potential for the development of problem behaviors in dogs in Japan compared with the United States. The Japanese preference for acquiring small breed dogs from pet stores may have been responsible for these negative behavioral effects, but further research is needed to clarify the precise causal mechanism (s) involved.

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