

Assessment of the Factorial Structures of the C-BARQ in Japan

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ABSTRACT. In order to introduce the Canine Behavioral Assessment and Research Questionnaire (C-BARQ), which is a standardized system for evaluating the behavioral traits of dogs, to Japan, where the environment with respect to dog ownership is thought to differ from those of the United States and Europe, we compared demographic information on dogs in the United States and Japan and examined whether similar factors could be extracted from both countries using questionnaire items of the C-BARQ. The C-BARQ was completed by 11,410, and 734 dog owners respectively in the United States and Japan, and some demographic differences were found, such as breed and neuter status. Data from completed questionnaires were subjected to factor analysis, and the resulting factors were tested for reliability. In the United States, factor analysis yielded 11 factors from 63 items that accounted for 52.9% of the common variance. In Japan, 15 factors were extracted, and these accounted for 57.0% of the common variance. The present factors for the United States were almost identical to the factors identified in a previous study, and similar factors were extracted in both countries. Therefore, the C-BARQ can function effectively as a fundamental behavioral evaluation system for dogs in Japan.

KEY WORDS: behavior, canine, C-BARQ, factor analysis, questionnaire.

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In the United States and Europe, behavior problems of dogs account for 17–20% of reasons that owners relinquish their pet dogs to animal shelters, and substantial numbers of these dogs are eventually euthanized [2, 5, 19, 23, 25]. In addition, many dogs suffer unnecessarily from inappropriate punishments and aversive training methods as a consequence of behavior problems [8]. These inappropriate treatments for dogs often worsen the problems and create a vicious cycle. In Japan, there were an estimated 13,101,000 pet dogs in 2008 [13]. Of these, 105,195 adult dogs and 24,742 puppies were relinquished to animal shelters [20]. Additional estimates suggest that 29,942 of these dogs were either returned to their owners or adopted by new owners, while 98,556 dogs were eventually euthanized. Because official research has not been conducted yet, it is not known exactly why these dogs were relinquished [20]. In order to resolve these issues, it is important to establish a system for classifying and naming behavioral traits in dogs. Researchers in the United States and Europe have developed some behavioral tests to evaluate the behavioral traits of dogs [14, 21, 28, 30]; however, it is not easy to conduct these behavioral tests, and the possibility exists that the emergence of particular behaviors may be dependent on experimental circumstances during the test. On the other hand, observer ratings can be convenient and useful tools through careful experimental designs [18]. However, observation by third parties has the practical difficulty of observing pet dogs in their natural and home environment. Therefore, in order to

understand the reality of behavior problems, it is effective to obtain the information about the dogs from their owners, who may know best the typical behaviors of the dogs, by an appropriate and reliable questionnaire. Serpell and Hsu [26] found the factors consistent for dogs of various breeds and either sex in regard to behavioral traits in guide dogs. Furthermore, Hsu and Serpell developed a questionnaire (Canine behavioral assessment and research questionnaire: C-BARQ) for measuring behavioral traits in pet dogs by using data of 2,054 dogs in the United States [11], and this has been used as the behavioral index in gene studies about behavioral traits of dogs [15, 31]. C-BARQ, which evaluates a dog's behavior objectively, can be a powerful tool for screening dogs for behavior problems and in evaluating the clinical effects of various treatments for behaviors [10, 29, 32]. Use of the C-BARQ will lead to early detection and understanding of behavioral traits that are responsible for behavior problems, and thereby, dogs can be offered appropriate treatments. C-BARQ can show whether the behavioral traits of the dog are within the normal range among all dogs or the dog's own breed. Furthermore, C-BARQ can also contribute by assisting new dog owners in choosing dogs that match their lifestyles.

Therefore, C-BARQ may be able to contribute to decreasing the relinquishment and euthanasia of dogs in Japan. However, in order to introduce C-BARQ to Japan, where the environment with respect to dog ownership is thought to differ from the United States and Europe, it is necessary to verify the factor structure of the C-BARQ in Japan. For example, Japanese people tend to own smaller-sized dogs compared with people in the United States and Europe. In Japan, dogs that weighed five kilograms or less accounted

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for about 40% of household dogs in 2009 [13]. In contrast, the most common breeds in the United States were shown to be large-sized breeds, such as Labrador Retrievers (12.4%), Golden Retrievers (10.1%), and German Shepherd Dogs (6.3%) [11]. Generally, the United States and Japan are considered to differ in terms of the living environment or view regarding castration. Therefore, it is necessary to examine the validity of the C-BARQ in Japan because these differences may influence the evaluation by C-BARQ. In the present study, we examined the difference of factors extracted from both the United States and Japan using the questionnaire items of Hsu and Serpell [11], as well as investigating the demographic differences among dogs in the United States and Japan.

MATERIALS AND METHODS

Subjects: The questionnaire recipients in Japan were recruited from dog training classes, pet shops and community events. We handed out the questionnaires to volunteers and asked them to mail the completed surveys back. A cover page requesting information on the dog's breed, age, sex and neuter status was also attached to the questionnaire. C-BARQ data from the United States were collected via the Internet using the freely accessible website: <http://www.C-BARQ.org>.

Questionnaire: The questionnaire in the present study included 66 items of Hsu and Serpell [11] without distinction of the sex of adult strangers. The method of answering items was based on Hsu and Serpell [11]. The original C-BARQ was translated into Japanese by two behavioral professionals and corrected by two professors. The details of C-BARQ in Japanese are available on the following website: <https://sites.google.com/a/carazabu.com/car/inu-rabo/CbarqTableUSandJapan.pdf?attredirects=0&d=1>.

Statistical analyses: Demographic data of dogs were analyzed by *t*-test and χ^2 tests (both test were 2-tailed). Data from the completed questionnaires were subjected initially 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. Results are expressed as means \pm SD (SPSS v.17.0, SPSS Japan Inc., an IBM company). In order to examine whether there were differences between the data of both countries in the present survey, a confirmatory factor analysis was conducted (Excel VBA macro, Kojima, 2003) [22, 34].

RESULTS

C-BARQ questionnaires were distributed to 1,024 dog owners in Japan, and 734 were returned (response rate 71.7%). Because dogs that were <1 or >7 years old or had

severe or chronic health problems were excluded, 440 questionnaires (43.0%) were considered valid. The response rates for each of 66 items in the questionnaire ranged from 83.9% to 100.0% (median, 99.4%, mode, 100.0%). Three items with response rates < 85.0% were excluded from further analyses, leaving 379 (37.0%) completed questionnaires that could be used in factor analyses. The remainder could not be used because of values missing for one or more items.

Among the 11,410 questionnaires completed in the United States, 3,288 satisfied the above requirements (28.8%). The response rates for each of 66 items in the questionnaire ranged from 90.5% to 99.8% (median, 98.5%, mode, 99.3%). All questionnaires that were returned could be used in factor analyses.

The average age of the dogs was 46.0 ± 21.1 months in the United States and 39.2 ± 20.0 months in Japan. This was a significant difference ($t(3,664) = -6.22$, $p < 0.01$). There were no significant differences in the sex ratios of dogs between the 2 countries ($\chi^2(1) = 0.87$, $p = 0.35$). There were significantly more neutered/spayed dogs in the United States than in Japan ($\chi^2(1) = 52.97$, $p < 0.01$). This information is summarized in Table 1.

Confirmatory factor analysis: We conducted a confirmatory factor analysis on the data of both countries by using the four main factors that were presented in Hsu and Serpell's study [11] (for the US, $\chi^2(293) = 7583.883$, $n = 3288$, $p < 0.01$, Goodness of Fit Index [GFI] = 0.839, Adjusted Goodness of Fit Index [AGFI] = 0.808, Standardized Root Mean Square Residual, [SRMR] = 0.053 and Root Mean Square Error of Approximation [RMSEA] = 0.087; and for Japan, $\chi^2(293) = 1034.445$, $n = 378$, $p < 0.01$, GFI = 0.823, AGFI = 0.788, SRM = 0.069 and RMSEA = 0.082). These statistical results demonstrated the similarity between the structure of the data obtained from both countries [1, 16].

Factor analysis: Sixty-three of the Japanese questionnaire items were grouped into 16 factors by means of factor analysis. After removal of items with an absolute value of factor loadings < 0.4, the remaining items were analyzed by factor analysis again. As a result, the items were divided into 15 factors that accounted for 57.0% of the common variance in item scores (Table 2). Internal consistency of each factor was examined by calculating the Cronbach's α . Twelve of the 15 factors had adequate α values; however, three factors had values < 0.70 (0.68, 0.64, and 0.44).

Because 3 items were excluded in the Japanese analysis, these three items were also excluded from the United States C-BARQ data. Sixty-three items were grouped into 13 factors by means of factor analysis. After removal of items with factor loadings < 0.4, the remaining items were analyzed by factor analysis again. As a result, the items were divided into 11 factors that accounted for 52.9% of the common variance in item scores (Table 2). Internal consistency of each factor was examined by calculating the Cronbach's α , and all factors were found to have adequate α values.

For the United States data, the factor analysis extracted factors that were very similar to the factors originally extracted by Hsu and Serpell [11]. However, although the

Table 1. Demographic information of the dogs

	United States N=3,288		Japan N=379	
	(n / %)		(n / %)	
Age	46.0 ± 21.1 months old		39.2 ± 20.0 months old	
Sex	Male	(1,687/51.3)	Male	(203/53.6)
	Female	(1,601/48.7)	Female	(176/46.4)
	Neutered/spayed	(2,381/72.4)	Neutered/spayed	(205/54.5)
Breed*	Labrador Retriever	(186/5.7)	Toy Poodle	(63/16.7)
	German Shepherd	(138/4.2)	Miniature Dachshund	(50/13.2)
	Rottweiler	(118/3.6)	Chihuahua	(23/6.1)
	Australian Shepherd	(100/3.0)	Shiba	(22/5.8)
	Border Collie	(98/3.0)	Welsh corgi	(15/4.0)
	Doberman Pinscher	(98/3.0)	Golden Retriever	(14/3.7)
	Golden Retriever	(96/2.9)		
	Collie	(92/2.8)		
	Soft Coated Wheaten Terrier	(83/2.5)		
	Mastiff (English)	(76/2.3)		
	Australian Cattle Dog	(58/1.8)		
	Jack Russell Terrier	(57/1.7)		
	Cocker Spaniel (American)	(54/1.6)		
	Boxer	(43/1.3)		
	Portuguese Water Dog	(42/1.3)		
	Bernese Mountain Dog	(41/1.2)		
	Siberian Husky	(40/1.2)		
	Airedale Terrier	(38/1.2)		
	Akita	(37/1.1)		
	American Pit Bull Terrier	(37/1.1)		
	Rhodesian Ridgeback	(37/1.1)		

* Breeds accounting for 50% of the total number of subject dogs in each country.

items related to aggression toward unfamiliar dogs and the items related to fear toward unfamiliar dogs were included in the same factor according to Hsu and Serpell [11], these items were divided into two factors in the present study. The factor ‘touch sensitivity’ was not extracted. The factors extracted by factor analysis are shown below (Table 2); factor 1 for the United States (US) and Japan (J) related to aggression towards strangers approaching or invading the dog’s or owner’s personal space, territory or home range (8 items for the US and 12 items for J). Factor 1 for J included aggression towards unfamiliar dogs or other animals (questions 23, 24 and 27; see Table 2) and fear towards unfamiliar visitors (q. 39). However, because the cross-loadings of 3 items (q. 23, 24 and 39) were higher on other factors than on factor 1, factor 1 for both countries was labeled ‘stranger-directed aggression.’ Factor 2 for the US related to aggression toward the owners or other members of the household when challenged or approached when in possession of food or objects (5 items). Therefore, this factor was labeled ‘owner-directed aggression’. On the other hand, in Japan, the items related to aggression toward the owners were divided into two factors; factor 5 for J related to aggression when in possession of food or toys, and factor 6 for J related aggression and fear toward the owners or other members of the household when challenged, manhandled or when possessions were taken away. These factors were respectively labeled ‘possession-related aggression’ and ‘owner-directed aggression / fear’. Factor 3 for the US related mainly to fear

of sudden or loud noises and to unfamiliar objects and situations (6 items). This factor was labeled ‘nonsocial fear’. Factor 4 of J was also labeled ‘nonsocial fear’ (4 items). The items related to a tendency to vocalize when separated from the owner and accompanied or preceded by behavioral signs were included in factor 4 for the US (7 items) and factor 2 for J (4 items). Factor 4 for the US included autonomic signs of anxiety such as loss of appetite, trembling and excessive salivation. Both factors were labeled ‘separation-related anxiety’. Five items related to a tendency to react strongly to potentially exciting or arousing events such as going for a walk or a car trip, doorbells, arrival of visitors, and the owner arriving home were included in factor 5 for the US, which was labeled ‘excitability’ (5 items). The same items were divided into two factors in Japan; factor 10 for J was related to a tendency to react to going for a walk or a car trip (2 items), and factor 13 for J related to a tendency to react strongly to door bells, arrival of visitors and return of owners (2 items). These factors were respectively labeled ‘outing-related excitability’ and ‘visitor-related excitability’. The items related to a tendency to maintain close proximity to the owner or other members of the household and to become agitated when the owners give attention to third parties were included in factor 6 of the US data and labeled ‘attachment and attention-seeking behavior’ (4 items). The same items were divided into two factors in Japan; factor 7 for J was related to a tendency to maintain close proximity to the owner or other members of the household (3 items),

Table 2. Results of factor analysis of a questionnaire for evaluating behavior and temperament traits in dogs of the United States and Japan

The United States			
Item	% of Variance*	α	Loading
Factor 1—stranger-directed aggression	9.37	0.91	
Dog acts aggressively			
(16) When an unfamiliar person approaches the owner or a member of the owner's family away from home			0.79
(10) When approached directly by an unfamiliar adult while being walked or exercised on a leash			0.79
(15) When an unfamiliar person approaches the owner or a member of the owner's family at home			0.73
(28) Toward unfamiliar persons visiting the home			0.72
(12) Toward unfamiliar persons approaching the dog while it is in the owner's car			0.70
(11) When approached directly by an unfamiliar child while being walked or exercised on a leash			0.68
(18) When mailmen or other delivery workers approach the home			0.66
(22) When joggers, cyclists, roller skaters, or skateboarders pass the home while the dog is in the yard			0.58
Factor 2—owner-directed aggression	5.89	0.87	
Dog acts aggressively			
(19) When food is taken away by a member of the household			0.89
(17) When approached directly by a member of the household while it is eating			0.82
(13) When toys, bones, or other objects are taken away by a member of the household			0.78
(31) When a member of the household retrieves food or objects stolen by the dog			0.76
(9) When verbally corrected or punished by a member of the household			0.52
Factor 3—nonsocial fear	5.82	0.81	
Dog acts anxious or fearful			
(48) In response to wind or wind-blown objects			0.70
(38) In response to sudden or loud noises			0.70
(42) In response to strange or unfamiliar objects on or near the sidewalk			0.68
(47) When first exposed to unfamiliar situations			0.60
(41) In heavy traffic			0.55
(44) During thunderstorms			0.53
Factor 4—separation-related behavior	5.58	0.83	
Dog displays			
(58) Whining when left or about to be left on its own			0.72
(57) Restlessness, agitation, or pacing when left or about to be left on its own			0.69
(59) Howling when left or about to be left on its own			0.66
(61) Loss of appetite when left or about to be left on its own			0.58
(60) Barking when left or about to be left on its own			0.58
(55) Shaking, shivering, or trembling when left or about to be left on its own			0.53
(56) Excessive salivation when left or about to be left on its own			0.52
Factor 5—excitability	4.32	0.83	
Dog overreacts or is excitable			
(66) Just before being taken for a walk			0.87
(67) Just before being taken on a car trip			0.86
(68) When visitors arrive at its home			0.50
(63) When a member of the household returns home after a brief absence			0.44
(65) When the doorbell rings			0.43
Factor 6—attachment and attention-seeking behavior	4.20	0.75	
Dog displays			
(71) Tends to sit close to or in contact with a member of the household when that individual is sitting down			0.80
(70) Tends to follow a member of household from room to room about the house			0.74
(72) Tends to nudge, nuzzle, or paw a member of the household for attention when that individual is sitting down			0.58
(69) Displays a strong attachment for a particular member of the household			0.51
Factor 7—trainability	4.05	0.76	
Dog			
(3) Obeys a stay command immediately			0.75
(2) Obeys a sit command immediately			0.70
(1) Returns immediately when called while off leash			0.58
(4) Seems to attend to or listen closely to everything the owner says or does			0.54
(6) Is slow to learn new tricks or tasks (reverse scoring)			0.44
(7) Is easily distracted by interesting sights, sounds, or smells (reverse scoring)			0.40
Factor 8—stranger-directed fear	3.34	0.88	
Dog acts anxious or fearful			
(36) When approached directly by an unfamiliar male adult while away from the home			0.79
(37) When approached directly by an unfamiliar child while away from the home			0.70
(39) When unfamiliar persons visit the home			0.64
Factor 9—chasing	3.15	0.74	
Dog			
(75) Chases cats if given the chance			0.82
(76) Chases birds if given the chance			0.66
(27) Acts aggressively toward cats, squirrels, and other animals entering its yard			0.56
Factor 10—dog-directed aggression	2.81	0.93	
Dog acts aggressively			
(24) When approached directly by an unfamiliar female dog while being walked or exercised on a leash			0.85
(23) When approached directly by an unfamiliar male dog while being walked or exercised on a leash			0.83
Factor 11—dog-directed fear	2.54	0.84	
Dog acts anxious or fearful			
(46) When approached directly by an unfamiliar dog of a smaller size			0.80
(45) When approached directly by an unfamiliar dog of the same or larger size			0.77

*Rotation Sums of Squared Loadings.
 Extraction Method: Maximum Likelihood.
 Rotation Method: Varimax with Kaiser Normalization.
 () indicates the item number of the questionnaire.

and factor 15 for J related to a tendency to become agitated when the owners give attention to third parties (2 items). These factors were respectively labeled 'attachment and attention-seeking behavior' and 'intervention-of-third-party-related attention-seeking behavior'. Factor 7 for the US was labeled 'trainability' and included 6 items related to

a willingness to attend to the owner, obey simple commands, respond positively to correction and ignore distracting stimuli. The same items were divided into two factors in Japan; factor 11 for J related to a willingness to attend to the owner, obey simple commands and respond positively to correction (3 items), and factor 14 for J related to slowness

Table 2. Results of factor analysis of a questionnaire for evaluating behavior and temperament traits in dogs of the United States and Japan (Continue)

Japan			
Item	% of Variance*	α	Loading
Factor 1—stranger-directed aggression	10.50	0.90	
Dog acts aggressively			
(20) When strangers walk past the home while the dog is in the yard			0.77
(22) When joggers, cyclists, roller skaters, or skateboarders pass the home while the dog is in the yard			0.74
(18) When mailmen or other delivery workers approach the home			0.73
(10) When approached directly by an unfamiliar adult while being walked or exercised on a leash			0.72
(15) When an unfamiliar person approaches the owner or a member of the owner's family at home			0.72
(12) Toward unfamiliar persons approaching the dog while it is in the owner's car			0.71
(16) When an unfamiliar person approaches the owner or a member of the owner's family away from home			0.68
(11) When approached directly by an unfamiliar child while being walked or exercised on a leash			0.62
(27) Acts aggressively toward cats, squirrels, and other animals entering its yard			0.46
(24) When approached directly by an unfamiliar male dog while being walked or exercised on a leash			0.44
(23) When approached directly by an unfamiliar female dog while being walked or exercised on a leash			0.41
Dog acts anxious or fearful			
(39) When unfamiliar persons visit the home			0.43
Factor 2—separation-related behavior	5.13	0.81	
Dog displays			
(58) Whining when left or about to be left on its own			0.77
(60) Barking when left or about to be left on its own			0.76
(57) Restlessness, agitation, or pacing when left or about to be left on its own			0.71
(59) Howling when left or about to be left on its own			0.61
Factor 3—stranger-directed fear	4.12	0.86	
Dog acts anxious or fearful			
(36) When approached directly by an unfamiliar male adult while away from the home			0.77
(37) When approached directly by an unfamiliar child while away from the home			0.71
(39) When unfamiliar persons visit the home			0.60
Factor 4—nonsocial fear	4.11	0.73	
Dog acts anxious or fearful			
(48) In response to wind or wind-blown objects			0.70
(42) In response to strange or unfamiliar objects on or near the sidewalk			0.67
(44) During thunderstorms			0.55
(38) In response to sudden or loud noises			0.55
Factor 5—possession-related aggression	3.86	0.75	
Dog acts aggressively			
(19) When food is taken away by a member of the household			0.92
(17) When approached directly by a member of the household while it is eating			0.71
(13) When toys, bones, or other objects are taken away by a member of the household			0.52
Factor 6—owner-directed aggression / fear	3.73	0.66	
Dog acts aggressively			
(14) When bathed or groomed by a member of the household			0.70
(9) When verbally corrected or punished by a member of the household			0.52
(31) When a member of the household retrieves food or objects stolen by the dog			0.52
Dog acts anxious or fearful			
(50) When groomed or bathed by a household member			0.52
Factor 7—attachment and attention-seeking behavior	3.56	0.74	
Dog displays			
(71) Tends to sit close to or in contact with a member of the household when that individual is sitting down			0.86
(72) Tends to nudge, nuzzle, or paw a member of the household for attention when that individual is sitting down			0.69
(70) Tends to follow a member of household from room to room about the house			0.54
Factor 8—dog-directed aggression	3.07	0.94	
Dog acts aggressively			
(23) When approached directly by an unfamiliar male dog while being walked or exercised on a leash			0.82
(24) When approached directly by an unfamiliar female dog while being walked or exercised on a leash			0.79
Factor 9—chasing	2.93	0.75	
Dog			
(76) Chases birds if given the chance			0.81
(75) Chases cats if given the chance			0.73
Factor 10—outing-related excitability	2.90	0.81	
Dog overreacts or is excitable			
(66) Just before being taken for a walk			0.82
(67) Just before being taken on a car trip			0.75
Factor 11—trainability 1	2.85	0.67	
Dog			
(3) Obeys a stay command immediately			0.73
(2) Obeys a sit command immediately			0.71
(4) Seems to attend to or listen closely to everything the owner says or does			0.44
Factor 12—dog-directed fear	2.68	0.85	
Dog acts anxious or fearful			
(46) When approached directly by an unfamiliar dog of a smaller size			0.81
(45) When approached directly by an unfamiliar dog of the same or larger size			0.63
Factor 13—visitor-related excitability	2.59	0.72	
Dog overreacts or is excitable			
(65) When the doorbell rings			0.75
(68) When visitors arrive at its home			0.57
Factor 14—trainability 2	2.55	0.63	
Dog			
(6) Is slow to learn new tricks or tasks (reverse scoring)			0.98
(5) Is slow to respond to correction or punishment (reverse scoring)			0.49
Factor 15—intervention-of-third-party-related attention-seeking behavior	2.44	0.73	
Dog displays			
(74) Becomes agitated when a member of the household shows affection for another dog or animal			0.81
(73) Becomes agitated when a member of the household shows affection for another person			0.61

in learning and reactivity to commands (2 items, reverse scoring). These factors were labeled 'trainability 1' and 'trainability 2'. Factor 8 of the US data related to fear of strangers approaching directly (3 items), and the same items

were included in factor 3 for J (3 items). Both factors were labeled 'stranger-directed fear.' Factors 9 for the US and 9 for J related to a tendency to engage in predatory pursuit of cats, birds and other small animals and was labeled 'chas-

ing' (3 items for the US and 2 items for J). Factors 10 for the US and 8 for J related to a tendency to respond aggressively when approached directly by unfamiliar dogs (2 items for the US and 2 items for J). These were labeled 'dog-directed aggression'. Factors 11 for the US and 12 for J related to a tendency to respond fearfully when approached directly by unfamiliar dogs and was labeled 'dog-directed fear' (2 items for the US and 2 items for J).

DISCUSSION

Demographic differences: There were some differences in the demographic information of dogs between the United States and Japan. Although there were no significant differences in the sex ratios of dogs between the 2 countries, a significantly greater proportion of dogs in the United States were spayed/neutered compared with those in Japan. The 2 countries differed also in the types of breeds most popularly represented. In the United States data, 21 breeds accounted for about half the number of participant dogs, whereas only six breeds dominated in Japan. The top 21 breeds in the United States were mostly medium- or large-sized dogs, while only one large-sized breed was popular in Japan. It has been argued that the relatively low frequency of neutered/spayed dogs in Japan is due to Japanese-specific cultural opposition to surgical sterilization of animals. However, it is also possible that the popularity of small-sized dogs in Japan reduces the negative impact of behavior problems typically associated with intact dogs. The reason why dogs tended to be older on average in the United States may have been due to the fact that many of the Japanese participants in the study were recruited via training classes for young dogs. Such demographic differences might be expected to exert some influence on the results of the C-BARQ assessments of canine behavioral traits in the United States and Japan.

Confirmatory factor analysis: In order to examine whether there were differences between the structures of extracted factors obtained from the data of both countries in the present survey, we conducted a confirmatory factor analysis by using the four main factors that were presented in Hsu and Serpell's study [11]. Although the goodness of fit of the data of both countries was not relatively high, there was little difference between them. An ideal comparison of the confirmatory factor analysis would have been to select breed-, sex- and aged-matched samples from the United States and compare their data with Japanese data, but this was impossible because of the shortage of data in both countries. There is a possibility that the offset created by the demographic differences such as the breed representation and neuter status caused the similar goodness of fit for both the United States and Japan.

Factor analysis: Subsequently, we conducted factor analysis on the data of each country, and the results generated very similar factors. The differences between Japan and the United States were as follows: 1) some factors in the United States were divided into two factors in Japan (owner-

directed aggression, attachment and attention-seeking behavior, excitability and trainability), 2) fear-related items were intermixed in the aggression-related factors (stranger-directed aggression and owner-directed aggression) and 3) the order of the extracted factors differed between the two countries. Regarding the first difference, it is possible that this difference between the two countries resulted from a technical problem influenced by the difference of sample size. Next, the items of the first factor in Japan were almost the same as those in the United States ('stranger-directed aggression'), but some items showing a different trend were included in Japan. However, because the loadings of these items were low and most of them were included in other factors with higher loading scores, we named the first factor as stranger-directed aggression. Regarding the items showing a different trend, it is necessary to consider whether these items were influenced by sample size or the characteristics of Japanese dogs, such as the degree of socialization, the living environment and awareness of their owners. Finally, in Japan, the factors related to anxiety and fear tended to proceed in the order of factors, and there were factors that were composed of mixtures of aggression and fear items, which might result from the difference of degree of socialization between the two countries. In order to investigate the differences of behavioral traits between the two countries, further studies are needed to clarify the detailed differences of factorial structures of dog behavior between Japanese and the United States data by matching the ages, breeds and neuter statuses of the samples by random selection.

Compared with paper surveys, Internet surveys have been shown to be relatively diverse with respect to the demographic characteristics of subjects. Moreover, the differences in the environment in which subjects responded to questionnaires may influence the results [3, 7, 9]. However, in the present study, because the structures of the extracted factors obtained from the data of both countries were similar, we assumed that the survey method had a minor influence on the results. The fact that similar aggression and fear factors were extracted in both the United States and Japan suggests that the C-BARQ can function effectively as a reliable evaluation system of canine behavioral traits in Japan. Today, the efforts of organizations related to animal welfare have begun to be appreciated, and the number of pet dogs euthanized is on a declining trend in Japan. C-BARQ can provide more improvements to the present situation in Japan. Moreover, one of the most important problems in Japan is thought to be a breeding system that ignores the appropriate behavioral traits for living environments, and C-BARQ can contribute to evaluating the breed-specific appropriate behavioral traits and reducing congenital behavior problems.

Behavioral trait study: In human studies of personality factors, it has been strongly suggested that personality trait structure is replicated cross-culturally [17]. Furthermore, behavioral genetic studies have shown that most human psychological traits, such as the Five Factor Model, are substantially heritable [e.g., 30], with no or very small familial

(shared) environmental influences [12, 24, 33]. There is a large interest in dog behavioral genetics, which would reveal the human psychological trait mechanisms [4]. In addition, analyzing the data obtained from C-BARQ revealed clear breed differences regarding behavior [6, 10, 27, 32]. Therefore, although a sufficient sample size and further research in Japan are necessary to clarify whether the results of the C-BARQ can show the biologically based behavioral traits in dogs, use of the C-BARQ is advantageous to understand the genetic influences on behavioral traits and to possibly assist in identifying the genes responsible for behavioral disorders.

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