Behavioral Profiles of Feline Breeds in Japan

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ABSTRACT. To clarify the behavioral profiles of 9 feline purebreds, 2 Persian subbreeds and the Japanese domestic cat, a questionnaire survey was distributed to 67 small-animal veterinarians. We found significant differences among breeds in all behavioral traits examined except for "inappropriate elimination". In addition, sexual differences were observed in certain behaviors, including "aggression toward cats", "general activity", "novelty-seeking", and "excitability". These behaviors were more common in males than females, whereas "nervousness" and "inappropriate elimination" were rated higher in females. When all breeds were categorized into four groups on the basis of a cluster analysis using the scores of two behavioral trait factors called "aggressiveness/sensitivity" and "vivaciousness", the group including Abyssinian, Russian Blue, Somali, Siamese, and Chinchilla breeds showed high aggressiveness/sensitivity and low vivaciousness. In contrast, the group including the American Shorthair and Japanese domestic cat displayed low aggressiveness/sensitivity and high vivaciousness, and the Himalayan and Persian group showed mild aggressiveness/sensitivity and very low vivaciousness. Finally, the group containing Maine Coon, Ragdoll, and Scottish Fold breeds displayed very low aggressiveness/sensitivity and low vivaciousness. The present results demonstrate that some feline behavioral traits vary by breed and/or sex.
KEY WORDS: behavioral trait, breed differences, feline, questionnaire survey, sex differences.

The domestic cat is one of the most popular companion animals in Japan and across the world. In the United States (US), United Kingdom (UK), and Europe, the number of companion cats has surpassed that of dogs (the Pet Food Manufacturers' Association, http://www.pfma.org.uk/, the Pet Food Institute, http://www.petfoodinstitute.org/#, and the European Pet Food Industry, www.fediaf.org/index.html). The number of cats kept as pets in Japan reached 10 million in 2005 (Pet Food Manufacturers Association, Japan; http://www.jppfma.org/index.html [in Japanese]); however, the number of cats in Japan has not yet caught up with the number of dogs. As this number grows, the amount of purebred companion cats has been increasing. As in other countries, the domestic cat remains the most popular pet in Japan. There are 68 official cat breeds currently recognized by the American Cat Fanciers Association and the International Cat Association [14].

At the Veterinary Medical Center's behavioral clinic for companion animals in The University of Tokyo, we have observed 30 feline behavioral cases in several years. Twenty of these cases were purebred cats, and 10 were Japanese domestic cats. Interestingly, the most prevalent diagnosis of the purebred cats was "aggression toward humans or household cats" (14 cases, including all 7 of the Abyssinians), followed by "inappropriate elimination" (4 cases) and "compulsive behavior" (2 cases). The Japanese domestic cat mainly showed "inappropriate elimination" (6 cases), followed by "aggression toward humans or household cats" (3 cases) and "compulsive behavior" (1 case). Although the sample sizes may be too small to apply statistical analyses,

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this phenomenon suggests that purebred cats may have more aggression problems than Japanese domestic cats.

Recently, the entire genome of an Abyssinian cat was sequenced and posted on the National Center for Biotechnology Information web site (http://www.ncbi.nlm.nih.gov/genome/guide/cat/). Many investigators have used this species in neuroscience and comparative genomic studies and as a medical model of human disease; however, to date little attention has been directed towards behavioral traits and behavioral differences among breeds [6, 11]. This is simply because cats have been artificially selected on the basis of on aesthetic traits such as coat color [9]. In contrast, dogs have undergone intense artificial selection to meet various human demands such as hunting, guarding, and herding. Therefore, behavioral differences among dog breeds have been fully examined [2, 5, 7, 16, 20].

The goal of the present study was to gather information on the behavioral profiles of purebred cats in Japan and the Japanese domestic cat. This information could be important for future research in behavioral genetics and may also provide useful and reliable information to prospective cat owners.

MATERIALS AND METHODS

In total, 96 veterinary practitioners in Japan were asked to participate in this study. The study was conducted at the same time as a survey for dogs (2004–2005) according to the procedures described in previous surveys in the US and UK [2, 5, 7]. Only 67 veterinarians responded to the survey; the others failed to respond, because they had not treated multiple feline breeds. Twenty-eight veterinarians were recruited from the member mailing list of the Japanese Veterinary Society for the Study of Animal Behavior (http://

vbm.jp/ [in Japanese]) and the other 39 veterinarians were recruited by core members of the society. Out of 67 participants, 43 (64%) were males. The participants were from across the country (mainly in Tokyo and the Osaka area), and the average duration of clinical experience was 15.7 years (range, 1 to 50). All participants were contacted via fax or e-mail and sent the questionnaire, survey guide, and detailed descriptions of each rated behavioral trait. Twelve cat breeds were selected for the survey as representative Japanese breeds, including Abyssinian, American Shorthair, Chinchilla, Himalayan, Japanese domestic cat, Maine Coon, Persian, Ragdoll, Russian Blue, Scottish Fold, Siamese, and Somali. The Chinchilla is one of the Persian breeds and has a bright white coat with evenly scattered black tipping. The Himalayan was bred from Persians crossed with Siamese to combine the Siamese point coloring with the Persian type and is approved as an accepted color variation of the Persian breed after many years of crossbreeding. These two breeds and Japanese domestic cats are not always recognized by major registration organizations as distinct breeds. Therefore, we treated them as subbreeds in this study, since they are popular in Japan and their behavioral traits are thought to differ from registered breeds.

The questionnaire focused on 11 items: excitability, general activity, playfulness, aggression toward cats, aggression toward humans, demand for affection, timidity, nervousness, novelty-seeking, friendliness, and inappropriate elimination. The participants were asked to rank the 6 breeds from lowest to highest for the expression of each behavior; participants were permitted to assign the same rank to more than one breed. In addition, participants were asked to check whether males or females were more likely to exhibit the behavior. Methods for data processing were in accordance with previous reports for dogs [2, 5, 7, 20]. Total of 22–38 respondents evaluated behavior traits for each cat breed (the smallest number was for Somali and more than 29

for other breeds). The number of respondents also differed for each trait ranging between 14 and 38 with the minimum number for inappropriate elimination.

All of the statistical analyses were performed with Statgraphics Centurion XV (http://www.statgraphics.com/). Analyses included factor analysis using the principle factor method with varimax rotation (using data on all items except for "inappropriate elimination") and a cluster analysis using *Ward's* method. The cluster analysis was performed on the basis of scores for principle factors 1 and 2.

RESULTS

Differences among breeds in behavioral traits: Behavioral traits ranked in order of decreasing reliability when differentiating among cat breeds, as indicated by the magnitude of the F ratio, are shown in Table 1. There were significant breed differences for all behavioral traits examined (analysis of variance [ANOVA], $p<0.001$, $F_{(11, 234)}=$ 3.08 to 10.73) with the exception of "inappropriate elimination" (ANOVA, $p=0.122$, $F_{(11, 234)}=1.53$). Cat breeds were ranked in order of decreasing averaged score for each behavioral trait (Table 1). For the unfavorable traits "aggression toward humans", "aggression toward cats", and "nervousness", the four breeds with the worst (highest) scores were Chinchilla, Abyssinian, Siamese, and Russian Blue.

Sex differences in behavioral traits: An analysis of sex differences in the 11 behavioral traits is shown in Fig. 1. Veterinarians did not note sex differences in some behavioral traits, such as "playfulness", "demand for affection", and "timidity" (χ^2 test for goodness of fit, $p<0.005$, except for "timidity", with $p<0.05$; $\chi=4.31$ to 16.25, df=1). With respect to the other behavioral traits, significantly more veterinarians rated males as higher than females in their "aggression toward cats", "general activity", "novelty-seek-

Table 1. Behavioral traits ranked in order of decreasing reliability in differentiating between cat breeds, as indicated by magnitude of F ratio, and order of cat breeds

Behavioral characteristic	F ratio	P value	Cat breeds ranked in order of decreasing averaged score (each averaged score was shown under each cat breeds)
Friendliness	10.7	<.0001	JDC, ASH, Scottish Fold, Main Coon, Ragdoll, Russian Blue, Somali, Himalayan, Abyssinian, Siamese, Persian, Chinchilla 5.07, 4.75, 4.57, 4.38, 3.81, 3.53, 3.30, 3.11, 2.95, 2.58, 2.35, 2.03
General activity	10.4	<.0001	Abyssinian, JDC, Siamese, Russian Blue, ASH, Somali, Scottish Fold, Chinchilla, Ragdoll, Main Coon, Himalayan, Persian 5.24, 4.60, 4.41, 4.26, 4.22, 3.73, 2.90, 2.89, 2.76, 2.35, 2.22, 2.12
Novelty seeking	9.9	<.0001	ASH, JDC, Abyssinian, Russian Blue, Somali, Siamese, Scottish Fold, Ragdoll, Main Coon, Chinchilla, Himalayan, Persian 5.00, 4.92, 4.57, 3.90, 3.62, 3.58, 3.55, 3.21, 2.73, 2.67, 2.27, 1.88
Playfulness	7.6	<.0001	JDC, ASH, Abyssinian, Russian Blue, Scottish Fold, Siamese, Somali, Main Coon, Chinchilla, Ragdoll, Himalayan, Persian 4.89, 4.60, 4.46, 4.05, 3.76, 3.64, 3.58, 2.84, 2.70, 2.67, 2.33, 2.26
Excitability	6.6	<.0001	Abyssinian, Siamese, Chinchilla, Russian Blue, JDC, Somali, ASH, Main Coon, Himalayan, Persian, Scottish Fold, Ragdoll 4.79, 4.55, 4.49, 4.00, 3.69, 3.69, 3.44, 3.00, 2.73, 2.56, 2.56, 2.17
Aggression to humans	6.5	<.0001	Chinchilla, Abyssinian, Siamese, Russian Blue, Persian, Somali, ASH, JDC, Himalayan, Scottish Fold, Ragdoll, Main Coon 5.11, 4.55, 4.09, 3.88, 3.66, 3.43, 3.38, 3.32, 3.30, 2.61, 2.13, 2.03
Aggression to cats	4.9	<.0001	Chinchilla, Abyssinian, Siamese, Russian Blue, JDC, ASH, Somali, Himalayan, Persian, Scottish Fold, Main Coon, Ragdoll 4.70, 4.25, 4.25, 3.93, 3.86, 3.61, 3.41, 3.21, 3.08, 2.82, 2.26, 2.21
Affection demand	3.5	0.0002	JDC, ASH, Scottish Fold, Somali, Main Coon, Russian Blue, Siamese, Abyssinian, Ragdoll, Himalayan, Chinchilla, Persian 4.72, 4.42, 4.22, 3.70, 3.43, 3.36, 3.34, 3.32, 3.25, 3.04, 2.90, 2.52
Timidity	3.1	0.0006	Chinchilla, Abyssinian, Himalayan, JDC, Russian Blue, Persian, Scottish Fold, Somali, Siamese, Ragdoll, ASH, Main Coon 4.32, 4.25, 3.98, 3.72, 3.67, 3.47, 3.41, 3.40, 3.39, 3.02, 2.81, 2.49
Nervousness	3.1	0.0007	Chinchilla, Abyssinian, Siamese, Russian Blue, Somali, JDC, Himalayan, Persian, ASH, Scottish Fold, Ragdoll, Main Coon 4.62, 4.45, 4.03, 3.76, 3.68, 3.58, 3.56, 3.28, 3.05, 2.71, 2.70, 2.42
Inappropriate elimination	1.5	0.1223	Abyssinian, JDC, Russian Blue, Persian, Main Coon, Scottish Fold, Ragdoll, Siamese, Somali, Himalayan, ASH, Chinchilla 4.20, 4.02, 3.97, 3.73, 3.65, 3.57, 3.47, 3.25, 3.21, 3.19, 2.93, 2.78

JDC; Japanese domestic cat, ASH; American Shorthair
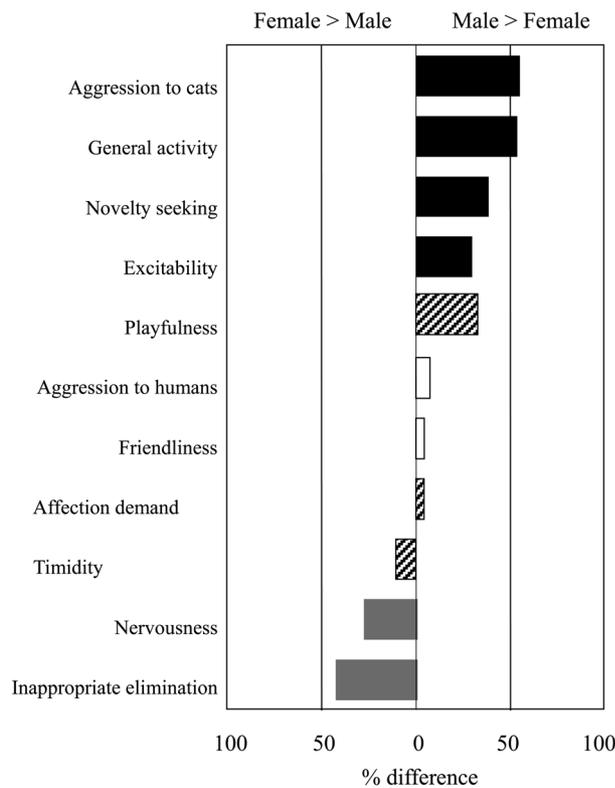
Female > Male   Male > Female

Fig. 1.   Analysis of sex differences for 11 behavioral traits. The quantitative rating was calculated as follows: (number of veterinarians rating males higher—those rating females higher) / total number of veterinarians × 100. The black columns indicate that males were rated significantly higher, the shadow columns indicate that females were rated significantly higher, and the hatched columns represent traits for which a significant number of veterinarians did not consider there to be a sex difference.

Table 2.   Factor loading(s) of each behavioral characteristic

Behavioral characteristic	Factor 1	Factor 2
Aggression to humans	0.881	
Aggression to cats	0.806	
Nervousness	0.817	
Timidity	0.671	
Excitability	0.603	0.451
Friendliness	−0.641	0.463
Playfulness		0.859
Novelty seeking		0.834
General activity		0.748
Affection demand		0.599

ing" and "excitability" (χ^2 test for goodness of fit, p<0.005, χ^2=10.53 to 32.40, df=1). In contrast, males were ranked lower than females for "nervousness" and "inappropriate elimination" (χ^2 test for goodness of fit, p<0.0005, χ^2=12.45 and 24.03, respectively, df=1).

Factor analysis: The factor analysis included data for all items except for "inappropriate elimination" and resulted in

the extraction of 2 main factors that had eigenvalues greater than 1.0. The two factors in combination accounted for 62.9% of the common variance, and each item belonged to more than 1 factor (the absolute value of factor loading was more than 0.4), as shown in Table 2. Factor 1, which was labeled as 'aggressiveness/sensitivity', accounted for 35.6% of the variance and was positively associated with "aggression toward humans", "aggression toward cats", "nervousness", "timidity", and "excitability" and negatively associated with "friendliness". Factor 2, which was labeled as 'vivaciousness', accounted for 27.3% of the variance and was positively associated with "playfulness", "novelty-seeking", "general activity", and "demand for affection".

Cluster analysis: The results of the cluster analysis using *Ward's* method applied to scores from each of the 2 factors are shown in Fig. 2. When all 12 breeds were categorized into four groups according to the distance among the clusters, Abyssinian, Russian Blue, Somali, Siamese, and Chinchilla (group 1) showed high aggressiveness/sensitivity and low vivaciousness, American Shorthair and Japanese domestic cats (group 2) displayed low aggressiveness/sensitivity and high vivaciousness, Himalayan and Persian (group 3) demonstrated mild aggressiveness/sensitivity and very low vivaciousness, and Maine Coon, Ragdoll and Scottish Fold (group 4) showed very low aggressiveness/sensitivity and low vivaciousness.

DISCUSSION

In the present study, significant differences among breeds were found for most of the behavioral traits examined. The lack of a difference for "inappropriate elimination" is inconsistent with previous data from our observation of behavioral cases and may be due to the difficulty of veterinarians in rating this trait. This is in accordance with the fact that the number of respondent was minimum for "inappropriate elimination". Many Japanese pet owners who have cats with "inappropriate elimination" problems hesitate to consult veterinarians and as a result, veterinarians rarely encounter this problem at their clinics. If we categorize the behavioral traits examined in this study into those that are favorable and those that are unfavorable, Japanese domestic cats and American Shorthairs are the highest-ranked breeds for favorable traits such as "friendliness", "playfulness", and "demand for affection", whereas Chinchilla, Abyssinian, Siamese, and Russian Blue breeds demonstrate unfavorable traits such as "aggression toward humans", "aggression toward cats", and "nervousness". However, it should be noted that, in contrast to the results of a similar survey for dogs [20], breeds known to exhibit these unfavorable traits are not always ranked lowest with regard to other traits (Table 1). The behavioral results for each breed shown in this study are consistent with the results of a past informal survey of cat-show judges [6]. In studies examining behavioral problems in cats, Siamese are evaluated for problems more often than expected, especially for aggression and ingestive behavioral problems [1]. In the present
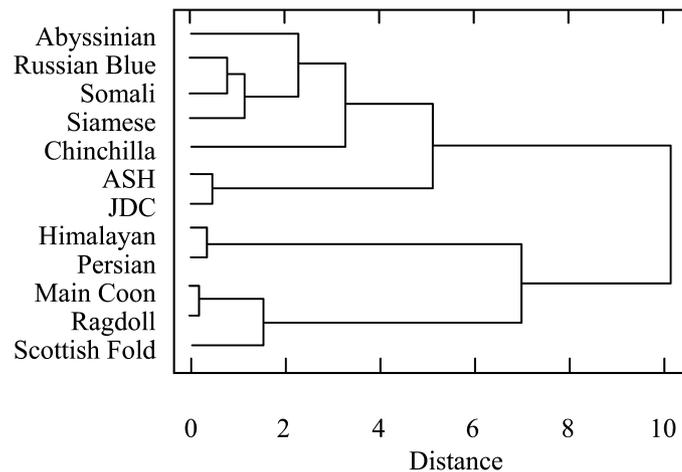
Fig. 2.   Cluster analysis according to the two factor scores, using *Ward's* method.

study, Siamese was ranked third in both "aggression toward humans" and "aggression toward cats". This result is consistent with findings from previous research [1], despite the studies being conducted in different regions.

In this study, we also observed sex differences in 6 behavioral traits, with females rated significantly higher than males in "nervousness" and "inappropriate elimination", and lower in "aggression toward cats", "general activity", "novelty-seeking", and "excitability". Interestingly, these results are very similar to what has been shown in dogs [20] except for "inappropriate elimination" and suggest that these behavioral traits may be regulated by sex steroid hormones [4, 13] in addition to being a species-level characteristic. Consistent with our results, previous studies have shown that aggression and house soiling are significantly over-presented by males as compared with females [1]. The minor discrepancy in the data for "aggression toward humans" may be due to differences in the intensity of aggressive behavior. That is, aggression toward humans may occur equally in both sexes but may be exhibited more strongly by males than females and thus more readily recognized as a behavioral problem by owners of male cats. It is interesting to note that "inappropriate elimination" was recorded as more frequent in females than in males by 32 veterinarians, whereas the other 32 veterinarians recorded no sex difference. The remaining three veterinarians noted "inappropriate elimination" as more frequent in males. One possible confounding factor is that we did not include urine marking (spraying) in the definition of the "inappropriate elimination". As a result, urine marking might not have been considered by participants in this survey but might have been in the previous study [1]. This inconsistency must be addressed in future research.

The 12 breeds were categorized into four groups according to the distance between clusters resulting from analysis yielding the 2 factors "aggressiveness/sensitivity" and "vivaciousness". Group 1 included Abyssinian, Russian

Blue, Somali, Siamese and Chinchilla; group 2 included American Shorthair and the Japanese domestic cat; group 3 included Himalayan and Persian; and group 4 included Maine Coon, Ragdoll, and Scottish Fold. This categorization may be useful for prospective cat owners; they can first select a favorable level of "aggressiveness/sensitivity" and "vivaciousness" and choose a breed based on these data. Although Persian and Himalayan, and Abyssinian and Somali exist nearby in the current results and a genetic study [12], the breeds in group 2 and group 4 are not genetic neighbors. This phenomenon is also shown in dogs [20] and suggests that behavioral traits do not always coincide with the process of the artificial selection.

Since the entire cat genome was sequenced in 2006, this species has been a focus for comparative genomic analyses and felidae evolution and history [3, 9, 12, 14, 15]. Although many hereditary diseases and phenotypes have been characterized at the molecular level [15], the relationship between behavioral traits and genetics in this species has not been examined, to the best of our knowledge. Recently, we and other groups started examining behavioral genetics in dogs [18] and have reported some relationships between behavioral traits and genetic polymorphisms [8, 10, 17, 19]. Based on the present results, we hope behavioral genetic studies in cats will begin in the near future.

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