The Ideal Care Robot for Dogs vs. Cats Based on an Online Survey

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ABSTRACT

Companion animals have been our social partners since ancient times. These animals, particularly dogs and cats, are also kept in households as family members. However, fewer people are able to take care of animals at home due to the increasing numbers of nuclear families and dual-income households. To investigate the need for care robots for companion animals, we conducted an online survey with dog and cat owners. In total, 1,521 and 1,219 people who have ever kept dogs and cats, respectively, completed our online survey. The results show that dog owners would prefer a humanoid care robots robot for dogs over machine-like robots, whereas cat owners showed the opposite preference; the results were statistically significant. In addition, there was a significant difference between dog and cat owners regarding owners' desires for a care robot to walk the animal outside.

CCS CONCEPTS

• **Human-centered computing** → *Human computer interaction (HCI)*; • **Social and professional topics** → *User characteristics*.

KEYWORDS

Pets, care robot, online survey, cats, dogs

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1 INTRODUCTION

Companion animals such as dogs and cats are considered irreplaceable family members[13] in human society. However, changes in people's lifestyles have led to various care devices such as automatic ball machines (e.g., iFetch), toilet machines (e.g., Brilliant-Pad), and feeding machines[10] being introduced in our daily lives. In addition, research on robots has been carried out in this domain. This research includes experiments using speaking physical agents in dog-training contexts[9, 11] and research on the recognition of

canine sociality in response to physical agents[1, 3–5, 7, 12]. However, most research on robots has been conducted on dogs rather than cats. It is thought that owners' opinions of suitable robots for their companion animals differ depending on the species. We investigated the differences in the propensity of dog and cat owners to use care robots and what behaviors they would want from their companion robots via an online survey.

2 METHODOLOGY

Suzuki et al. studied a robot that takes care of dogs with the aim of establishing positive interactions between dogs and robots. Furthermore, they conducted a preliminary survey that included 97 people who had experience in canine breeding to determine the design of the robot and their needs in terms of the desired care behavior before their main experiment[8]. In the survey, we investigated the tendencies in the similarities and differences between experienced dog and cat owners regarding their perceptions of robots that can care for their companion animals.

2.1 Questionnaire

The questionnaire items were the following four questions and a blank for each question to ask why the respondents chose their answer:

- Question 1: Would you want a robot to not only take care of your pet, but also take care of a human?
- Question 2: Would you want a robot to undertake all caretaking activities for your companion animal?
- Question 3: Which would be better for taking care of your companion animal, a humanoid robot or a machine-like robot?
- Question 4: Would you want a robot to do the following caretaking activities for your companion animal: feeding, cleaning the toilet, playing, walking outside, brushing, shampooing, cutting its nails, trimming, and training? (using a Likert scale where 1 = "I do not want a robot to undertake this care activity at all" to 5 = "I would really want a robot to take care of my animal in this regard" for each care activity).

The questionnaire was written in Japanese because most of the users in CloudWorks, which we used as a crowdsourcing platform, were Japanese.

2.2 Respondents

The survey was conducted using CrowdWorks from April 17th to May 1st, 2018. Responses were collected from people who had experience living with dogs (N = 1,521; male = 466, female = 1,055;

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mean age $\pm$ SD = 36.35 $\pm$ 10.35, no answer = 6) and with cats (N = 1,219; male = 368, female = 851; mean age $\pm$ SD 37.09 $\pm$ 10.13, no answer = 4).

3 RESULT

Fig. 1 shows the quantitative results of the answers to Questions 1–3. We calculated p -values using Pearson's Chi-squared test for Questions 1–3 to evaluate whether there was a tendency for there to be frequently related differences regarding the species of companion animals and preferences for care robots. We used the Mann-Whitney U test in Question 4 and IBM's SPSS version 22 software to evaluate whether there were differences in the care activities owners wanted from robots between dog and cat owners. In addition, we calculated the effect sizes r using Microsoft Office Excel as $r = z/\sqrt{N}$ for Question 4. We also calculated effect sizes r using Microsoft Office Excel as $r = z/\sqrt{N}$ for Question 4. We defined significant differences as p -values ≤ 0.05 .

In addition to our choice of the answers, we conducted a qualitative analysis based on the respondents' comments on each question after morphological analysis to extract major adjectives and nouns by generating word clouds with the MeCab package and word cloud in Python. We analyzed the results in Japanese and then visualized the top-ten most frequent words in the comments as shown in Figs. 2–4.

3.1 Question 1

In Question 1, there was no significant difference between dog and cat owners, with $\chi^2(1)=0.718$, $p=0.408$, Cramer's $V=0.0016$ as shown in Table 1.

Table 1: Cross-tabulation of Question 1.

		Would you want a robot to not only take care of your pet, but also take care of a human?			
		Yes	No	SUM	
Species	Dog	Frequency	581	940	1521
		Expected frequency	591.7	929.3	1521.0
		Adjusted residual	-.8	.8	
	Cat	Frequency	485	734	1219
		Expected frequency	474.3	744.7	1219.0
		Adjusted residual	.8	-.8	
SUM		Frequency	1066	1674	2740
		Expected frequency	1066.0	1674.0	2740.0

Although there were no significant differences between dog and cat owners in Question 1, there was a common tendency between those who chose "both of humans and animals" and "only animals" regardless of "dog" or "cat" ownership in the comments where respondents explained their choice. The respondents who chose "both humans and animals" mentioned "sanitation" and "separately" following general words like "robot," "care," "human," "because," "dog/cat," and "good" as shown in Fig. 2. Comments included "I worry about sanitary problems so I think that caring separately is better." from a dog owner (ID 26; 42-year-old male) and "Taking account of the sanitary problem, I think that a different care robot would be better" from a cat owner (ID 1205; 29-year-old female). Meanwhile, respondents who chose "only animals" mentioned "house" and "place" as shown in Fig. 2. Additionally, respondents used "annoying" and "space" in the top-20 in terms of frequency.

There were comments like "Because if there were multiple robots at home, the robots would occupy space." from a dog owner (ID 76; 42-year-old female) and "If one robot can care for both humans and cats, one robot would cost less than multiple robots" from a cat owner (ID 1150; 50-year-old female).

3.2 Question 2

In Question 2, there was a significant difference among the frequencies of the four groups with $\chi^2(1)=6.280$ and $p=0.012$, and the adjusted standardized residuals indicated both dog and cat owners preferred that a care robot could do all necessary care activities for their animals rather than having different respective robots do different tasks for their animals ($z=2.5$, $p<0.05$), as shown in Table 2. However, there was little correlation given by Cramer's $V=0.048$.

Table 2: Cross-tabulation of Question 2.

		Would you want a robot to undertake all caretaking activities for your companion animal?			
		Yes	No	SUM	
Species	Dog	Frequency	1314	207	1521
		Expected frequency	1290.6	230.4	1521.0
		Adjusted residual	2.5	-2.5	
	Cat	Frequency	1011	208	1219
		Expected frequency	1034.4	184.6	1219.0
		Adjusted residual	-2.5	2.5	
SUM	Frequency	2325	415	2740	
	Expected frequency	2325.0	415.0	2740.0	

The results of morphological analysis of respondents' comments show a common tendency between those who chose "yes" regardless of "dog" or "cat" ownership with words that appeared in the top-20 most frequent words, although it seemed difficult to see the tendency in the top-10 most frequent words in Fig. 3. The respondents who chose "yes" mentioned "necessity," "place," and "annoying". Comments included "If there were such many robots, they would be annoying" from a dog owner (ID 1250; 36-year-old female) and "If there were multiple robots, there would be a high possibility that cats would feel afraid. Even if it is just a cleaning robot, cats observe the robot and keep their distance." from a cat owner (ID 218; 45-year-old female). However, the respondents who chose "no" mentioned "function" in the top-20 most frequent words. Comments included "With multiple robots, there would be less trouble than implementing different motions and information to only one robot" from a dog owner (ID 1282; 22-year-old female) and "Separating the robots by function seems more convenient than not separating them." from a cat owner (ID 435; 40-year-old female).

3.3 Question 3

In Question 3, there was a significant difference among the frequencies of the four groups with $\chi^2(1)=48.784$ and $p=0.000$, and the adjusted standardized residual indicated that dog owners prefer humanoid robots as a care robot rather than machine-like robots. However, cat owners preferred a machine-like robot for their cats ($z=7.0$, $p<0.01$), as shown in Table 3. In addition, there was little correlation according to Cramer's $V=0.133$.

Figure 1: Results of the survey based on Q1 (left) to Q3 (right).

Figure 2: Wordclouds of dog-owners who chose "yes" (upper left) and "no" (upper right) and cat-owners who chose "yes" (bottom left) and "no" (bottom right) in Question 1.

Table 3: Cross-tabulation of Question 3.

		Which would be better for taking care of your companion animal, a humanoid robot or a machine-like robot?		SUM
		Humanoid robot	Care machine	
Species	Frequency	833	688	1521
	Expected frequency	742.2	778.8	1521.0
	Adjusted residual	7.0	-7.0	
	Frequency	504	715	1219
	Expected frequency	594.8	624.2	1219.0
	Adjusted residual	-7.0	7.0	
SUM	Frequency	1337	1403	2740
	Expected frequency	1337.0	1403.0	2740.0

The results of morphological analysis of the comments show there is a common tendency between those who chose "care machine" regardless of "dog" or "cat" ownership with words that appeared in the top-20 most frequent words although it seemed too

difficult to see the tendency of the top-ten most frequent words in Fig. 4. The respondents who chose "care machine" mentioned "necessary" in top-20 most frequent words. Regarding respondents who chose "humanoid robot," the dog owners mentioned "relief," "similar," and "attachment." For example, the comment "I guess that dogs would develop an attachment to a humanoid robot caring for them" came from a dog owner (ID 1146; 34-year-old female) while cat owners mentioned "relief," "similar" and "vigilance."

3.4 Question 4

In Question 4, there were significant differences in feeding, cleaning the toilet, walking outside, brushing, shampooing, and training between dog and cat owners, as shown in Table 4. Table 4 also

Figure 3: Wordclouds of dog-owners who chose "yes" (upper left) and "no" (upper right) and cat-owners who chose "yes" (bottom left) and "no" (bottom right) in Question 2.

Figure 4: Wordclouds of dog-owners who chose "humanoid robot" (upper left) and "machine-like robot" (upper right) and cat-owners who chose "humanoid robot" (bottom left) and "machine-like robot" (bottom right) in Question 3.

shows that the effect size r for all items except "walking outside" was minuscule.

Table 4: The results of statistical analysis on Question 4 (* = statistically significant difference between dog and cat owners at $p < 0.05$.)

	Average of the ranks		U	z	p	r
	Dog	Cat				
feeding*	1,308.84	1,447.44	833,257.50	-4.76	0.00	-0.09
cleaning the toilet*	1,326.12	1,425.88	859,542.00	-3.58	0.00	-0.07
playing	1,389.23	1,347.13	955,540.00	1.42	0.16	0.03
walking outside*	1,538.51	1,160.87	1,182,588.50	13.00	0.00	0.25
brushing*	1,412.10	1,318.60	990,316.50	3.16	0.00	0.06
shampooing*	1,420.70	1,307.87	1,003,399.50	3.84	0.00	0.07
cutting nails	1,372.96	1,367.43	930,792.00	0.19	0.85	0.00
trimming*	1,425.77	1,301.54	1,011,114.00	4.32	0.00	0.08
training	1,380.63	1,357.86	942,457.50	0.78	0.43	0.01

Table 5: The results of statistical analysis on Question 4 (* = statistically significant difference between dog owners in 2018 and in 2020 at $p < 0.05$.)

	Mean		z	p	r
	Dog (2018)	Dog (2020)			
feeding*	3.654	3.772	2.359	0.018	0.472
cleaning the toilet	4.088	4.148	1.061	0.289	0.212
playing*	3.336	3.484	3.104	0.002	0.621
walking outside	2.607	2.603	0.017	0.986	0.003
blushing*	2.732	2.855	2.699	0.007	0.540
shampooing*	2.571	2.673	2.193	0.028	0.439
cutting its nails*	2.458	2.593	2.655	0.008	0.531
trimming*	2.336	2.476	2.990	0.003	0.598
training*	2.318	2.519	4.403	0.000	0.881

4 IMPACTS OF COVID-19

Since Covid-19 has significantly affected people's lifestyles, there could be changes in pet owners' attitudes toward getting care robots for their animals. To investigate whether pet owners have changed their tendency, we conducted the same online survey utilizing CroudWorks from October 21st to November 3rd, 2020. In total, 2,000 dog owners (male = 573, female = 1,427) and 1,908 cat owners (male = 555, female = 1,353) took part in the online survey.

4.1 Result of the Online Survey in 2020

We conducted statistical analysis on differences in tendencies between dog owners and cat owners in 2018 and 2020. As a result of statistical analyses on Questions 1, 2, and 3, Cramer's V was too small (0.003–0.064) and the results were not significantly reliable. However, there were significant differences in Question 4 with sufficient effect size between dog owners in 2018 and 2020 as shown in Table 5 and between cat owners in 2018 and 2020 as shown in Table 6. All items of care activity with significant differences between pet owners in 2018 and 2020 had higher mean scores in 2020 than in 2018. In addition, the number of care activity items with a significant difference was higher among dog owners than among cat owners.

5 DISCUSSION

There was a difference in the preferences for care robots between dog and cat owners. The dog owners thought a humanoid robot

Table 6: The result of statistical analysis on Question 4 (* = statistically significant difference between cat owners in 2018 and in 2020 at $p < 0.05$.)

	Mean		z	p	r
	Cat (2018)	Cat (2020)			
feeding	3.883	3.927	0.873	0.383	0.175
cleaning the toilet	4.217	4.276	0.629	0.530	0.126
playing*	3.281	3.401	2.579	0.010	0.516
walking outside	1.920	1.957	0.689	0.491	0.137
blushing*	2.571	2.667	1.965	0.049	0.393
shampooing	2.372	2.364	0.178	0.859	0.036
cutting its nails*	2.459	2.594	2.400	0.016	0.480
trimming	2.107	2.154	0.975	0.330	0.195
training	2.270	2.286	0.154	0.878	0.031

is suitable for dogs in Question 3. Some respondents' comments in the open question asked for the reasons behind their choices in Question 3 implied what caused the difference. For example, a dog owner (ID 70; 53-year-old female) commented *the movements of a humanoid robot in caretaking were similar to those that humans usually did, which made dogs less uncomfortable*. The similarity of embodiment can positively affect dogs' perception toward a robot; for example, dogs are very sensitive to humans' non-verbal signals like pointing gestures or attention [2]. Dogs' perception of humans' pointing gesture is superior to primates [6]. Dog owners can observe dogs' social skills to interact with humans in their daily life, which might lead dog owners to prefer humanoid robots for their dogs. As the change of lifestyle caused by COVID-19 includes more home-working, which can let pet owners spend more time with their animals, pet owners seem to have more need for care-robots than before. In addition, dog owners are more affected by lifestyle changes than cat owners.

6 LIMITATION

Since the online survey in this paper was not an international survey, we should take cultural differences into account. If we were to conduct the same survey in another country, there exists the potential that neither dog nor cat owners would prefer humanoid robots to the same extent, making no significant differences between dog and cat owners in Question 3. As further work, we should conduct a wide online survey on an international scale.

7 CONCLUSION

To investigate pet owners' perceived need for care robots for companion animals, we conducted an online survey with dog and cat owners. In total, 1,521 people who had at some time kept dogs and 1,219 people who had at some time kept cats answered the online survey. Our results showed that dog owners prefer a humanoid robot to a machine-like robot and cat owners' preferred the opposite.

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