



Attitudes toward cat collar use in central European cat owners—An online survey

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ABSTRACT

Collar use in cats is a controversial topic. Cat owners do have very different reasons for either deciding to use a collar on their cat or rejecting collar use. We conducted an online survey on cat management, use of and attitudes toward collars. Our survey participants were mainly women (88.8%), mostly came from Germany (88.2%), and owned 2 ± 2 cats. Collar use was reported by 32.9%. Overall, participants showed significantly higher agreement to the subscale risk perception than to the subscale benefit perception ($Z = -56.997$, $P < 0.001$, $N = 4940$). Participants ($N = 318$) who reported first-time collar fitting on their cat in the past 2 years used most often plastic breakaway buckles (rounded edges: 44.2%; round with edges inwards: 17.9%; rectangular: 10.4%), non-breakaway buckles were used by 14.4% (plastic: 9.4%; metal: 4.9%). The most common objects attached to the collar were ID tags/tubes (32.4%) and bells (22.1%) and tracker (19.7%). Based on lifetime experience, collar users were older, less often first-time owners, more often allowed their cats free roaming, and had less often professional experience with cats. Agreement to risks was lower than in non-users but still higher than agreement to benefits. In contrast, the perception of benefits outweighed perception of risks in recent collar users. Collar use in the past was strongly associated to risks from entrapment. This suggests that owners are willing to try collars but do not continue to use them over time as they may perceive more risks than benefits.

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Introduction

Collar use is a topic controversially discussed by cat owners and experts, similarly to the decision whether or not a cat should be allowed to freely roam outdoors (Foreman-Worsley et al., 2021). The main rationales for using cat collars are visible identification, mounting of radiofrequency tracking devices, or reduction of the impact of cat predatory behavior on wildlife in sensitive areas (for review, see Arhant et al., 2022a). Still, cat owners do have very different reasons for either deciding to use a collar on their cat or

rejecting collar use (Harrod et al., 2016). According to data collected by means of owner interviews and an online survey (Calver et al., 2013; Harrod et al., 2016), many owners refrain from collar use because they fear that wearing a collar might have negative effects on their cats. Reasons given by owners are that collars are unsafe (e.g., injury or death connected to collar use), that their cat keeps losing the collar, or that their cat does not tolerate a collar (Calver et al., 2013; Harrod et al., 2016). Only a few studies focused on investigating the safety of different types of cat collars (Lord et al., 2010; Calver et al., 2013; Arhant et al., 2022b). The major risks when using collars are the entrapment of the collar on an object (e.g., a branch) or the entrapment of a body part in the collar (e.g., the paw, forelimb, or lower jaw of the cat) (Arhant et al., 2022a). The possible sequelae are strangulation of the cat or serious injury (Lascelles and White, 2001; Calver et al., 2013; Arhant et al., 2022b). We assessed risks related to free roaming (getting lost, injuries due to traffic accidents, and bite incidents) and risks related to collar use via an online survey, which was also used to collect data for the current study, and found that most collar-related incidents were minor

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(Arhant et al., 2022b). Collar incidents causing injury were reported in 4% of cats, and we found that 0.6% of cats died from a collar incident. These cats mostly got entrapped on branches or fences and died of strangulation. Most fatal collar incidents happened more than 10 years ago; materials and latch mechanisms used in collar construction have since developed immensely. Compared to other risk of free roaming, such as death due to a traffic accident (up to 16%) or never returning home (up to 13%), the risk of dying due to a collar-related incident is quite low. Further, up to 34% of cats got involved in fights with other animals (up to 1% of cats died from an injury received from a fight). Nevertheless, the use of cat collars is still a very controversial topic due to the potential, albeit low risk of severe injury or death.

On the plus side collars can be useful in identifying cats or for mounting tracking devices (Huang et al., 2018; Klune et al., 2021). Our past study showed that using more than one type of identification increased the likelihood of reunions after going missing, and tracking devices could indeed be used successfully by cat owners to locate their missing pet cat (Arhant et al., 2022b).

Attitudes are used as a major concept to explain and predict human behavior (Ajzen and Fishbein, 1980). Attitudes are shaped by experience, but normative beliefs and control beliefs also play a role. Normative beliefs describe one's perception of how we think people important to ourselves might behave or want us to behave; control beliefs reflect if a person believes they have the capacity to carry out a behavior (Ajzen and Fishbein, 2005). Former studies assessing owner attitudes toward the risks and benefits of cat collar use found high agreement regarding risks such as entrapment and injury (Calver et al., 2013). Frequent collar loss and intolerance of cats to wear a collar were further reasons why owners avoided using collars (Harrod et al., 2016). Benefits most relevant to cat owners were the identification and reduction of predatory behavior (Harrod et al., 2016).

We here set out to explore owner attitudes most influential in the decision-making process regarding collar use and investigate if recommendations for collar use, such as breakaway buckles, avoidance of elastic materials, proper fit, and cat training, are considered by owners. Further, we explore sources of information on collar use and aim to identify factors potentially relevant for the decision of owners to use a collar on their cat. To this aim, we conducted an online survey. Due to the nature of the study (exploratory, observational), we did not include a priori hypotheses. As inherent to such epidemiological approaches, we set to test for associations based on assumptions.

Methods

All procedures applied during the course of this study were discussed with the institutional ethics committee (of the Veterinary University of Vienna) as well as the ethics committee of the University of Medicine, Vienna. To provide an overview of the study, both the overall project proposal (including other research questions published separately (Arhant et al., 2022b)), and the overall questionnaire itself were submitted. These committees also confirmed that no ethics vote was necessary, in accordance with guidelines for Good Scientific Practice and with Austrian national legislation.

The questionnaire

A questionnaire on cat management, use of collars, and incidence of risks of free roaming with a total of 224 questions (in German, questions in English see [Supplementary Material](#)) was developed based on a review of the literature, informal discussions with cat owners, and a German companion animal-registry organization (TASSO e.V.). In this paper, we will report the results on collar use and attitudes toward collars.

Information on cat management and characteristics of the owner and their cats was gathered. Questions about attitudes toward collars and opinions regarding different risks of collar use (scored on a five-point scale: do not agree at all, rather not agree, partly agree, rather agree, totally agree) were included. Further, the questionnaire contained questions regarding sources of information on cat husbandry and collars, on collar use (e.g., type of collar/buckle) in the past 2 years, the process of fitting a collar to a cat (e.g., with or without habituation), and the long-term use of collars.

Parts of the questionnaire the participants had no experience with, or did not wish to answer, could be skipped. Therefore, the sample size (N) can differ between questions. We deliberately decided against mandatory questions in order to minimize reactance and drop-out rates in participants while increasing the quality of answers (Décieux et al., 2015). The respective sample size is mentioned in relevant parts in the results section.

We tested a draft version of the questionnaire with persons from the target population and experts from the companion animal-registry organization TASSO e.V. to incorporate feedback on unclear aspects regarding the contents and the surveying process. To complete the revised final questionnaire, participants needed between 10 and 30 minutes (depending on the amount of information provided). Results of other topics addressed in the questionnaire (e.g., incidents with collars) are presented elsewhere (Arhant et al., 2022b).

The survey

The survey was performed as an online survey via SurveyMonkey between February and April 2021. It was advertised via social media and via the TASSO newsletter. TASSO e.V. is the largest free companion animal registry in Europe and operates mainly in German-speaking countries; it has 10 million registered companion animals, of which 4 million are cats; for more information, see <https://www.tasso.net/Presse>. Before starting the actual questionnaire, participants were informed about the aims of the study, that the data would be analyzed anonymously, and that they could discontinue at any point. To reduce the risk of introducing sampling bias, the information about the study aims and the advertisements was purposely kept very nonspecific to avoid attracting only certain participants. Only after providing informed consent, participants could start the questionnaire.

Data analyses

Statistical analyses were carried out with IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA), R (4.1.2), and RStudio (2022.07.0).

Descriptive analyses were conducted for characteristics of the participants and their cats, their use of sources of information on cat ownership and collars, collar use in the past 2 years, the process of fitting a collar to a cat, and long-term use of collars.

Principal component analyses (PCAs) were used to summarize attitude toward and experience with collars to meaningful factors. Altogether, two PCAs followed by Varimax rotation were run for items related to attitudes toward collars and personal experience with risks of collars. Bartlett's test of sphericity was required to be significant, and the Kaiser-Meyer-Olkin criterion should be at least 0.6. To include items in the final solution, the anti-image correlation matrix diagonal was required to be at least 0.5, and subscales were required to have an eigenvalue greater than one (Kaiser criterion). Items were included in subscale scores only if they had a loading of at least 0.45 and did not have a loading higher than 0.4 on any other component. The 12 items intended to assess attitudes toward collars resulted in two components with eigenvalues greater than one explaining 51.8% of the variance. However, one item (collars get lost repeatedly) had a double loading and was not included in the final

solution. The seven items assessing opinions regarding different risks of collar use (only answered by collar users) resulted in two components explaining 79.7% of the variance. To allow for comparisons with the original scale and ease of interpretation, the subscale scores were obtained by calculating the mean of the items in each subscale.

Due to deviations from the normal distribution, attitudes toward collars and the number of sources of information on cat ownership were compared between collar users and nonusers by means of Mann-Whitney U-tests. Bonferroni correction for multiple comparisons was carried out based on four tests performed. This led to a value of $P < 0.0125$ considered to be significant. A Wilcoxon test was used to compare the extent of agreement regarding the subscale risks and benefits within participant. Further, the agreement of collar users regarding different risks of collar use (subscales problems with entrapment and problems with coat/skin) was compared within participant. Cross tabulations were used to assess differences in sources of information on cat ownership between collar users and noncollar users. Bonferroni correction for multiple comparisons was carried out based on nine tests performed. This led to a value of $P < 0.005$ considered to be significant.

Moreover, generalized linear models were calculated to analyze factors associated with collar use over the lifetime and the past 2 years. An overview of the included factors, including the wording of questions and coding for the models, is provided in Table 1. Before fitting any models, we created data subsets including only relevant variables for both the lifetime and 2-year analysis pipeline: The lifetime data set included the variables *collar use*, *risk perception*, *benefit perception*, *owner experience* (i.e., first-time cat owner yes/no), *years of experience as cat owners*, *access to free roaming*, *sources of information on cat husbandry*, *work situation* (i.e., if the participant professionally works with cats), *access to veterinary care*, *participant sex*, *participant age*, and *living situation*. The 2-year subset included the variables *collar use*, *risk perception*, *benefit perception*, *owner experience* (i.e., first-time cat owner yes/no), *years of experience as cat owners*, *access to free roaming*, *work situation* (i.e., if the participant professionally works with cats), *participant age*, *problems with coat/skin*, *problems with entrapment*. We excluded all rows containing missing values to guarantee data sets of equal length independent of the number of variables used in each model. The full models included all variables of the subset, respectively, with *collar use* as the response variable. The null model included none of the variables. The subset used for the 2-year analysis had fewer data points, so only variables identified as relevant in the lifetime analysis additional to the variables *problems with coat/skin* and *problems with entrapment* were used. The statistical analysis of the lifetime and 2-year data was not driven by hypotheses based on null-full model comparisons, but rather an exploratory search for potentially influential factors affecting the use of collars in domestic cats. All results underwent null-full model comparisons of generalized linear models with binomial distribution and have been checked for stability, overdispersion, singularity, variance inflation, and model assumptions. The full-null model comparison of both the lifetime and 2-year data indicated the full model to be significantly better than the null model. The full model was then used for a model averaging approach to determine the most influential factors predicting our data distribution. All steps leading up to and including the full-null model comparison follow a very widely used approach (for more details, see Mundry, 2011). We further used model averaging through the MuMIn package function dredge (Barton, 2022). This function allows for a comparison between all possible models derived from the full model. The model with the lowest AICc (Second Order Akaike Information Criterion) score and all models within a delta of 2 from this score are chosen as mathematically equally good and averaged (Burnham and Anderson, 2004). A confidence interval of 85% (compatible with the averaging approach) in combination with a

relative importance rating was used to evaluate each factor's relevance (Arnold, 2010). Only variables with an importance rating of 1 (=100%) were considered relevant.

Results

The participants

A total of $N = 5,347$ respondents answered the first question relevant to this study, that is, question 3 regarding country of origin (Q1: consent, Q2: "How did you hear about our survey?"). Of those 4573 respondents completed the questionnaire until they reached the last section on owner demographics, leading to a completion rate of 85.5%.

Our survey participants were mainly women (88.8%; 10.8% men; 0.4% diverse; $N = 4564$) on average 48.5 ± 12.9 years of age. They mainly came from Germany (88.2%, Austria: 10.8%, other central European countries: 1%, $N = 5,347$) and lived in rural areas (39.7%), big cities (21.4%), small towns (16.7%), medium-sized towns (14.4%), and suburban areas (7.8%, $N = 4,573$). An academic degree held by 34.6%, and 5.4% of the participants worked with cats professionally (of which 27.2% in a veterinary practice, 16.9% in the animal shelter, 12.8% as consultant on, e.g., behavior/nutrition, 2.9% in a pet shop, 40.3% other types mainly foster care/breeder/cat sitter).

Thirty-nine percent of participants owned only one cat (61% pair or multicat households, $N = 5,224$), and 15.4% were first-time owners ($N = 5,265$). The mean duration of cat ownership was 19 ± 13 years, and participants owned on average 2 ± 2 cats at the time of responding to the questionnaire. Ninety-six percent of the owned cats were neutered, and 79% were microchipped and registered through a pet registry. Of the participants, 75.5% had no purebred cats; 62.2% of the cats had outdoor access since their owners allowed them to roam freely ($N = 5,222$).

General attitudes toward collar use and risks of collars

Collar use was reported by 32.9% of our participants ($N = 5136$). In general, single statements regarding risks received higher agreement (on average "rather agree" on a five-point scale: do not agree at all/rather not agree/partly agree/rather agree/totally agree) than statements regarding benefits (on average "rather not agree" or "partly agree"; Table 2). Overall, participants showed significantly higher agreement to the subscale risk perception than to the subscale benefit perception (risk perception: 4.2 ± 0.9 ; benefit perception: 2.2 ± 0.9 ; Wilcoxon test: $Z = -56.997$, $P < 0.001$, $N = 4940$). Furthermore, there were significant differences between users and nonusers with respect to their attitudes toward collars. Nonusers agreed more with risks and less with benefits (risk perception: users: 3.7 ± 0.9 ; nonusers: 4.4 ± 0.6 ; $Z = -27.753$, $P < 0.001$, $N = 5010$; benefit perception: users: 2.5 ± 0.8 ; nonusers: 2.0 ± 0.7 ; $Z = -18.379$, $P < 0.001$, $N = 4998$). Highest concerns were associated with getting entangled and getting injured or dying from an incident (Table 2). Among a pregiven list of potential benefits, highest perceived benefits (although still rated with "partly agree" by the average collar user) were identification and retrieval, better visibility, and reduction of bird predation. Reduction of predation received similar ratings by users and nonusers. The item asking about loss of collar dropped out of the PCA due to double loadings. On average all cat owners rather agreed that collars get lost repeatedly; collar users indicated higher agreement (users: 4.1 ± 1.1 ; nonusers: 3.9 ± 1.1 ; $Z = -9.318$, $P < 0.001$, $N = 4982$).

Opinions of collar users (excluding antiparasite collar users) regarding the occurrence of health issues showed most agreement in entrapment on objects such as bushes and trees (3.8 ± 1.3 on a five-point scale), followed by entrapment of body parts (e.g., paw/jaw; 3.3 ± 1.5), death caused by entrapment (3.2 ± 1.6), problems with

Table 1
Predictor variables and their meaning used in models regarding collar use of cat owners (lifetime/recent use within past 2 years) to explore influential factors relevant for the decision whether to use a collar on their cat.

Predictor variable	Model—lifetime use	Model—use in past 2 years	Question	Coding
Risk perception = Attitudes toward risks of collars	Yes	Yes	See Table 2	Mean score of six items (scored on five-point scale) included in subscale
Benefit perception = Attitudes toward benefits of collars	Yes	Yes	See Table 2	Mean score of five items (scored on five-point scale) included in subscale
Owner experience	Yes	Yes	First-time cat ownership recoded from “How many cats did you have before the ones that are currently with you?”	No Yes
Years of experience as cat owners	Yes	Yes	How many years have you been keeping cats?	In years
Access to free roaming	Yes	Yes	Recoded from “Do your current cats have outdoor access?”	Confined (only indoor or protected areas) Free roaming allowed
Sources of information on cat husbandry	Yes	No	From where do you obtain information about cats?	Number of sources used (Internet, personal contact with other cat owners, lectures/conferences, magazines, books, veterinarian, pet shop, via an association)
Work situation (i.e., if the participant professionally works with cats)	Yes	Yes	Recoded from “Do you work professionally with cats?”	No Yes (including animal shelter, veterinary practice, pet shop, consultant (e.g., behavior, nutrition), another profession)
Access to veterinary care	Yes	No	How often on average do you present your current cats to the veterinarian?	Never Less than once a year Once a year Several times per year Several times per month
Participant sex	Yes	No	What is your sex?	Female Male
Participant age	Yes	No	How old are you?	Nonbinary
Living situation	Yes	No	Where do you live?	In years Big cities Suburban Medium-sized towns Small towns Rural areas
Problems with coat/skin = Experience of collar users	No	Yes	Alterations of the coat Skin alterations, for example, redness, inflammation Wounds	Mean score of three items (scored on five-point scale) included in subscale
Problems with entrapment = Experience of collar users	No	Yes	Getting the collar caught on objects, for example, bushes/trees Getting paw/jaw caught in collar Injuries, for example, wounds/fractures due to getting caught Death, for example, caused by getting caught	Mean score of four items (scored on five-point scale) included in subscale

Table 2

Descriptive statistics and component loadings of questionnaire items targeting attitudes toward risks and benefits of collars that were summarized in two PCA components.

PCA component (in bold) and items included	Component loading	Collar use											
		No						Yes					
		N	Mean	SD	Perc 25	Median	Perc 75	N	Mean	SD	Perc 25	Median	Perc 75
Risk perception		3348	4.4	0.6	4.08	4.5	4.83	1662	3.7	0.9	3	3.83	4.33
A collar is a safety hazard for cats.	0.819	3415	4.6	0.8	4	5	5	1682	3.8	1.2	3	4	5
Cats can get caught and injured with a collar.	0.795	3431	4.6	0.7	5	5	5	1686	4.0	1.1	3	4	5
Cats can die if they get trapped with a collar.	0.761	3418	4.7	0.7	5	5	5	1680	4.1	1.1	3	5	5
Cats are not comfortable with collars.	0.704	3410	4.1	1.0	3	4	5	1682	3.2	1.3	2	3	4
Cats try to get the collar off, for example, by scratching the collar.	0.670	3392	4.1	1.0	3	4	5	1681	3.5	1.3	3	4	5
If a cat is microchipped, it does not need a collar.	0.565	3414	4.3	1.1	4	5	5	1682	3.5	1.4	2	4	5
Benefit perception		3350	2.0	0.7	1.4	2	2.6	1648	2.5	0.8	1.8	2.4	3
A collar facilitates the retrieval of cats.	0.776	3403	2.3	1.2	1	2	3	1680	2.9	1.2	2	3	4
A collar prevents cats from getting lost.	0.679	3416	1.9	1.1	1	1	3	1680	2.4	1.2	1	3	3
A collar makes cats more visible.	0.668	3399	2.1	1.1	1	2	3	1677	2.8	1.3	2	3	4
A collar with bells prevents cats from catching birds.	0.574	3404	2.6	1.4	1	3	4	1677	2.6	1.4	1	3	4
A collar makes a cat look beautiful.	0.458	3421	1.4	0.8	1	1	1	1675	1.7	1.1	1	1	2
Collars are repeatedly lost.	Excluded	3312	3.9	1.1	3	4	5	1670	4.1	1.1	3	5	5

Components are referred to subscales in the text and were labeled “risk perception” and “benefit perception.”

Scored on a five-point scale from “do not agree at” all to “totally agree.”

SD, standard deviation.

Table 3

Proportion of cat owners using specific sources of information on collar use and cat husbandry.

	Sources of information about collars reported by collar users (N = 1132)	Sources of information on cat husbandry reported by all participants (N = 4558)
	% Use	% Use
Internet	64.2%	86.5%
Personal contact with other owners	25.1%	56.3%
Lectures/Conferences	0.9%	4.0%
Magazines	14.0%	22.2%
Books	11.6%	33.4%
Veterinarian	41.3%	82.2%
Pet shop	27.9%	11.9%
Via an association	3.7%	11.0%
Other source	2.4%	5.9%

coat (3.1 ± 1.4), injuries such as fractures or deep wounds caused by entrapment (2.9 ± 1.5), problems with skin such as redness/inflammation (2.5 ± 1.4) and excoriations/wounds through chafing of the collar (2.3 ± 1.4). Overall owners agreed that the main concern in collar use was entrapment compared to coat or skin problems (problems with entrapment: 3.3 ± 1.3 , problems with coat/skin: 2.7 ± 1.2 ; $Z = -16.948$, $P < 0.001$, $N = 1462$). Rated as the most important reason to fit a collar to their cat was identification (3.2 ± 1.6), increased visibility (2.9 ± 1.6), and parasite control (2.7 ± 1.6). However, the average owner still stated these reasons to be only partly important. Other less relevant reasons received even lower importance ratings such as reduction of predation (2.2 ± 1.4 ; corresponding to “rather not important”), use of tracking devices (2.1 ± 1.5), use of an electronic cat flap (1.7 ± 1.3), and “good looks” (1.3 ± 0.8 , corresponding to “not important,” $N = 1342$).

In addition, owners who never used collars on their cats ($N = 3405$) were asked to provide the reasons why they refrained from doing so. They were most concerned about collars being dangerous (77%), increased risk of injury (73%), and the potential negative effects on cat welfare (55%). One-third viewed collars as unnecessary (e.g., because of indoor housing) (35%). 22% had heard reports of bad experiences with collars, 13% feared irritation of the skin due to collar use or received advice to avoid collar use. 12%

stated collar loss as a reason to not use collars. Only 0.1% viewed them as too expensive.

Sources of information on cat ownership collar use

The average collar user reported using two sources of information about cat collars (Table 3). The average cat owner (users and nonusers) reported the use of three sources of information about cat husbandry (i.e., keeping and caring for cats); there was no significant difference between collar users and nonusers (users: 3.1 ± 1.2 ; nonusers: 3.1 ± 1.2 ; $Z = -0.459$, $P = 0.646$). The most common sources of information about cat husbandry were the internet (86.5%), veterinarian (82.2%), and personal contact to other cat owners (56.3%). The most common resources to gather information on collar use were the internet (64.2%), veterinarian (41.3%), and pet shops (27.9%). We also looked for significant differences between collar users and nonusers regarding the specific sources of information on cat husbandry and found no difference, except for pet shops (users: 15.4%, standardized residual [s.r.] = 3.8, nonusers: 10.4%, s.r. = -2.5, $\chi^2 = 23.116$, $P < 0.001$). Overall, fewer sources to gather information on cat collars were reported as compared to gathering information on keeping and care of cats (Table 3). Only pet shops were more commonly reported as sources of information on collars (27.9%) than as information sources on cat husbandry (11.9%).

Collar use in the 2 years prior to completion of the survey

Of the participants reporting collar use at some point in the past ($N = 1674$), only 43.4% had used a collar on their cats within the last 2 years. Solely antiparasite collars had been used by 11.2%, whereas other collar types had been used by 32.2%. Of those that had used other types of collars, 82.4% had reportedly sought information about collar use prior to the actual use. The most commonly used types of collars were fully elastic or partly elastic (Table 4). The most common buckle type was a standard breakaway plastic buckle and other plastic breakaway buckles (round, rectangular). The most common objects attached to the collar were ID tags and bells. Global positioning system (GPS) trackers were slightly more common than radio trackers. Antipredation fabric collars, paper collars, and collars with magnetic buckles were rarely used.

Table 4

Proportion of participants reporting frequency of using specific collar types, buckles, and objects attached to the collar during the last 2 years.

Collar types, buckles, and attached objects	N	Never (%)	Seldom (%)	Sometimes (%)	Often (%)	Always (%)
Collar types						
Nonelastic—paper	407	97.3	0.7	0.7	0.2	1.0
Nonelastic—different materials	431	54.1	10.7	7.9	10.7	16.7
Partly elastic	434	47.2	10.4	12.4	13.4	16.6
Fully elastic	432	47.9	5.3	9.7	12.7	24.3
Buckle types						
<i>Nonbreakaway buckle</i>						
A: metal	449	85.7	3.8	3.1	3.3	4.0
B: plastic	451	79.2	4.0	5.8	6.2	4.9
<i>Breakaway buckle</i>						
C: plastic with rounded edges	466	37.6	8.8	16.1	17.4	20.2
D: round plastic with edges inwards	453	64.7	6.6	10.6	9.7	8.4
E: rectangular plastic	451	73.2	5.1	9.3	6.4	6.0
F: sphere or egg-shaped	444	89.2	2.0	4.3	2.5	2.0
G: magnetic	444	93.0	2.0	2.3	0.9	1.8
H: adjustable to weight of cat	455	81.8	1.3	3.1	4.8	9.0
Other buckle types	414	89.4	1.0	2.2	2.9	4.6
Attached objects						
ID tags/tubes	499	46.9	6.0	7.0	6.6	33.5
GPS-tracker	481	84.8	1.0	3.7	3.1	7.3
Radio-tracker	482	90.0	0.6	1.7	1.7	6.0
Bells	490	58.0	10.6	8.8	8.0	14.7
Light	472	93.6	2.1	1.9	1.5	0.8
Antipredation fabric collar	479	98.3	0.2	0.6	0.2	0.6
Other object	456	85.3	1.1	1.5	1.5	10.5

GPS, global positioning system

Getting a cat used to a collar and long-term use

Participants who reported first-time collar use in the last 2 years (27.2%, N = 1488) were asked questions about the process of getting their cat used to the collar. In total, 318 participants provided answers about this process; antiparasite collar users were excluded as fitting of and cat reactions to antiparasite collars were not the focus of this research. The cats were, on average, 2.3 ± 3.1 years old. They were most often fitted with partly elastic collars (40.3%), followed by nonelastic collars of different materials (36.2%), fully elastic collars (22.9%), and least often paper collars (0.6%; N = 315). These collars had most often plastic breakaway buckles (plastic with rounded edges: 44.2%; round plastic with edges inwards: 17.9%; rectangular plastic: 10.4%), followed by nonbreakaway buckles (plastic: 9.4%; metal: 4.9%), nonspecified buckle types (4.5%) or other types of breakaway buckles (adjustable to weight of cat: 3.6%; magnetic: 2.9%; sphere or egg-shaped: 2.3%; N = 308). Participants who sought information about collar use prior to fitting their cat with a collar reported using breakaway collars in 86.1% of cases compared to 80.4% breakaway collars in participants who did not seek information prior to use. However, this difference was not statistically significant ($\chi^2 = 1.189$, $P = 0.276$, N = 294). Of the participants, 66.3% reported that different types of objects were attached to the collar; most common were ID tags/tubes (32.4%) and bells (22.1%; GPS-

tracker: 13.1%; radio-tracker: 6.1%; light: 1.3%; antipredation fabric collar: 0.3%; N = 312).

Immediate fitting without prior habituation to the collar was reported by 54.4% of the cat owners, whereas 25.9% habituated their cats, for example, by repeatedly fastening the collar without the use of food treats and 19.6% used treats during this process (N = 316). The time period for habituation was mostly a few days (24.6%), followed by 2–3 weeks (14%), 1 week (9.6%), 1–2 months (4.3%), or 3 months or longer (2%; N = 301).

Cats that were not habituated to the collar showed behavioral changes during the first 2 weeks of wearing the collar: mainly increased scratching and grooming of the collar site (Table 5). Those that were habituated still showed behavioral changes after the habituation process (Table 5). Most prevalent were scratching the collar site, and changes in resting and grooming behavior. During the first 2 weeks of wearing a collar, resting was reduced, whereas grooming increased.

Of the cats for which the process of first-time fitting was reported, 41.5% still wore the collar they were first fitted with (and which was described in the questionnaire). For 10.3% of the cats, the collar had been exchanged, and 48.2% of the cats did not wear a collar anymore (N = 311).

For those cats that still wore a collar, owners reported the frequency of loss and safety measures to reduce incidents with collars

Table 5

Reports of reduction, consistency, and increase in behaviors from a pregiven list among participants that indicated to have or have not habituated their cats to the collar (in the percentage of participants that reported first-time collar use on a specific cat in the last 2 years).

	No habituation				Habituation			
	Reduced		Same		Reduced		Same	
	N	%	%	%	N	%	%	%
Scratching collar site	138	6.5	49.3	44.2	139	17.3	44.6	38.1
Relaxed resting	136	3.7	90.4	5.9	141	16.3	75.2	8.5
Grooming	136	1.5	85.3	13.2	141	6.4	75.2	18.4
Object play	135	3.0	95.6	1.5	141	11.3	87.2	1.4
Scratching of objects	126	0.8	97.6	1.6	139	6.5	87.8	5.8

Table 6

Reports of safety measures taken in relation to collar use (in the percentage of participants that reported first-time collar use on a specific cat in the last 2 years and reported that their cat still wore a collar).

	N	Never	Every few month	Less than once a month	Once a month	Every one to 2 wk	Weekly	Multiple times per week	Daily
Visual control of collar	162	1.9	2.5	1.2	2.5	3.1	8.6	11.1	69.1
Tactile control of fit and comfort	162	1.9	1.2	0.6	2.5	3.1	8.6	14.8	67.3
Control of collar material	162	3.7	2.5	1.9	5.6	4.3	13.6	11.7	56.8
Change of collar	159	26.4	42.8	11.9	6.9	1.9	2.5	0.6	6.9

(Table 6). No loss of the collar within a period of 3 months was reported by 53.1%; 38.8% of respondents reported collar loss one to three times, 3.8% four to nine times, and 4.3% 10-times or more often.

Factors associated with collar use (lifetime and past 2 years)

Here, we present the results from the model averaging approach. The models presented underwent all testing described above (see “Methods”) to explore the most relevant factors associated with collar use (based on lifetime experience and in the past 2 years).

A total of 4171 responses were included in the analysis of lifetime experience with collar use. The full model included the response variable collar use and the variables risk perception, benefit perception, duration (years) of cat experience, first-time owner, living environment, free roaming, veterinary care, and owner characteristics (age, sex, professional cat experience, number of sources of information on cat ownership). The null model included none of the variables. After completing full-null model comparison ($\text{Pr} [> \text{Chi}] \leq 2.2 \times 10^{-16}$) model averaging indicated fixed factors owner age, risk and benefit perception, duration of owner experience (years), first-time ownership, professional experience/work with cats and free roaming to be relevant in explaining the data distribution (Table 7, Figure 1). Our model found that collar users (based on lifetime experience) were older, more experienced, and less often first-time owners. They more often allowed their cats to

free roam, perceived lower risks and higher benefits from collars, and had less often professional experience with cats (Figure 1).

A total of 1074 responses were included in the analysis of collar use in the past 2 years. The full model included the response variable collar use, and the predictors included all variables identified as relevant for lifetime use (attitudes regarding the perception of risks and benefits of collars, whether the owner was a first-time owner and years of experience with keeping cats, whether the cat was allowed free roaming, and the owner characteristics “age” and “professional experience”). Additionally, two variables assessing opinions of collar users regarding certain risks of collar use (problems with coat/skin, problems with entrapment); these two new variables were included since participant answers regarding problems with coat/skin and problems with entrapment were only collected from current collar users. The null model included none of the variables. After completing full-null model comparison ($\text{Pr} [> \text{Chi}] \leq 2.2 \times 10^{-16}$) model, averaging indicated fixed factors: owner age, risk and benefit perception, owner experience (in years, first-time owner), free roaming, and problems with entrapment to be relevant in explaining the data distribution (Table 7, Figure 2). Surprisingly, in contrast to lifetime use, our model showed that experienced owners reported collar use in the past 2 years less often as compared to first-time owners. Again, collar users allowed their cats more often free roaming and perceived lower risks and higher benefits from collars. Moreover, they agreed less to problems with entrapment (Figure 2).

Table 7

Model averaged coefficients of all linear models for collar use.

Parameter	Estimate	Std. error	CI (85 %)		Relative importance
			7.50%	92.50%	
<i>Lifetime collar use</i>					
(Intercept)	4.1008	0.3785	3.556	4.6455	
Owner age in years	−0.0133	0.0037	−0.0186	−0.008	1
Benefit perception	0.3289	0.0572	0.2466	0.4112	1
Number of information sources on cat keeping	0.0232	0.0327	−0.0006	0.0932	0.5
Owner experience—first-time owner	−0.5711	0.1327	−0.762	−0.3801	1
Free roaming—confined	−1.0394	0.0884	−1.1666	−0.9122	1
Risk perception	−1.2724	0.0605	−1.3595	−1.1852	1
Work with cats—yes	−0.4912	0.2003	−0.7795	−0.2028	1
Experience with keeping cats in years	0.0281	0.0037	0.0227	0.0335	1
Owner sex—men	−0.0515	0.1053	−0.2931	0.0824	0.49
Owner sex—diverse	0.5679	0.7314	0.2456	2.0769	0.49
<i>Collar use past 2 y</i>					
(Intercept)	3.7074	0.7015	2.698	4.7169	
Owner age in years	−0.0057	0.0079	−0.0224	0	0.51
Benefit perception	0.7009	0.1263	0.5191	0.8827	1
Problems with coat/skin	−0.0736	0.089	−0.2473	−0.013	0.57
Owner experience—first-time owner	0.6175	0.2908	0.1991	1.0359	1
Free roaming—confined	−0.5546	0.1918	−0.8305	−0.2786	1
Risk perception	−1.0954	0.1285	−1.2802	−0.9105	1
Problems with entrapment	−0.3572	0.0892	−0.4856	−0.2287	1
Experience with keeping cats in years	−0.0209	0.0082	−0.0327	−0.0091	1

Only variables with a minimum relative importance of 1 and a confidence interval not ranging over 0 are taken into consideration for model interpretation (shown in bold print). CI, confidence interval.

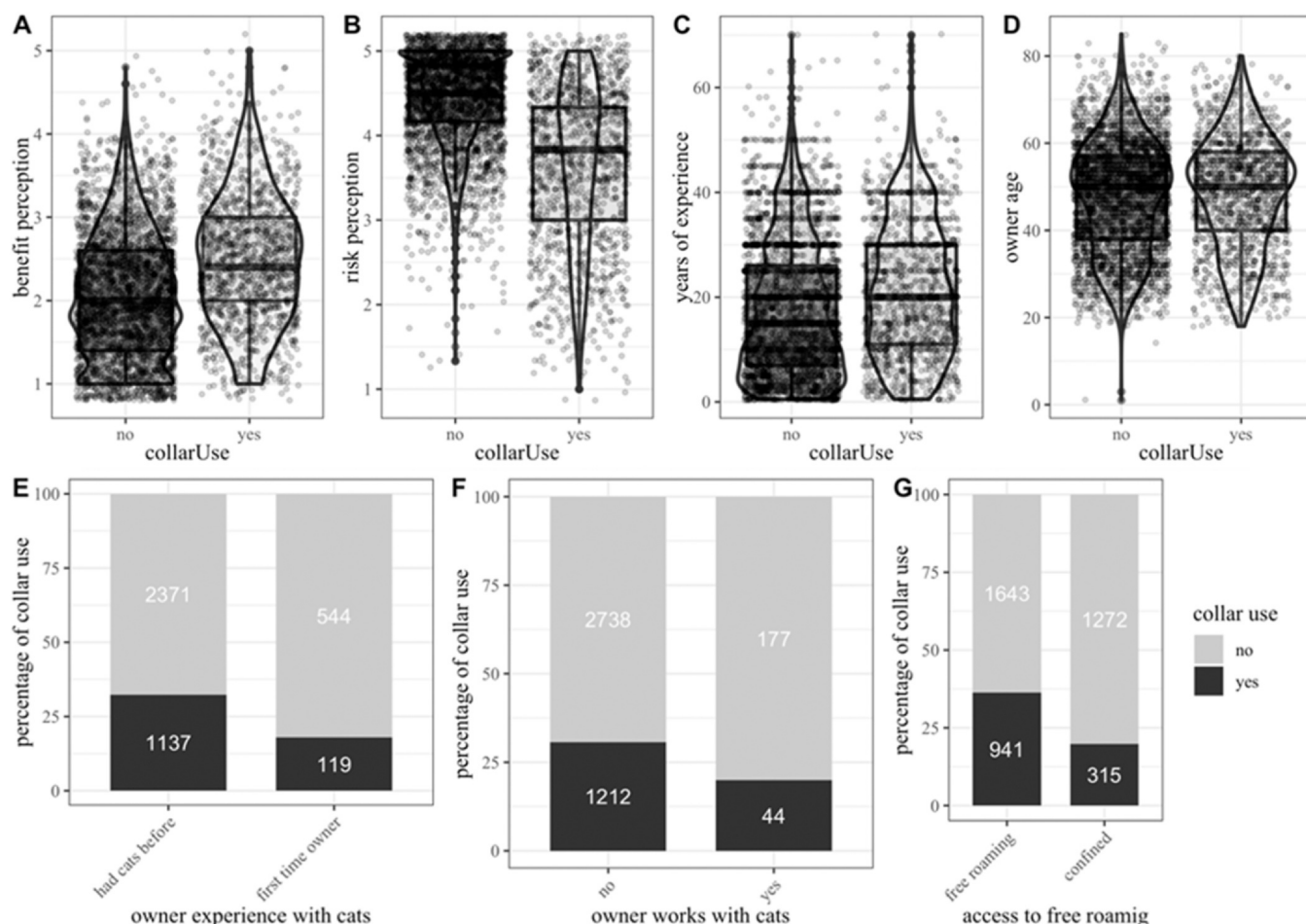


Figure 1. Factors relevant for lifetime collar use ($N = 4171$) illustrated in boxplots and violin plots or bar plots. A) benefit and B) risk perception toward collars split by collar use. The subscales benefit and risk perception were calculated following a principal component analysis. Subscale scores were obtained by calculating the mean of the items in each subscale. C) Duration (years) of cat ownership across nonusers and collar users. D) Age of participants in boxplots by user status. E) Percentage of collar use in first-time owners. F) Percentage of collar use in owners with professional experience with cats. G) Percentage of collar use in free-roaming cats. Noncollar users are marked in gray and collar users in black. The number of case reports contributing to each category is indicated as N in white.

Discussion

Former studies on collar use in cats identified cat owners concerns regarding risks of collar use (Calver et al., 2013; Harrod et al., 2016). Our results confirmed that statements regarding risks of collar use receive high agreement among participants. In contrast, attitudes toward benefits rated on the same five-point scale only received moderate to low agreement. The analysis of factors influencing the decision to use collars provided further insight in cat owners' assessment of risks versus benefits. When looking at attitudes toward risk and benefit perception in recent collar users (within past 2 years), benefits outweigh risks (Figure 2A–2C). However, for lifetime collar users, the extent of agreement concerning risks is much higher than agreement to perceived benefits (Figure 1A and 1B). Overall, this suggests that cat owners are willing to try collars, but over time benefits do not outweigh the risks of collars.

The most important reason for using a collar in our survey was identification. This is in accordance with Harrod et al. (2016) who reported that 27% of participants used collars for identification purposes; these data were collected through a binary “yes/no” approach. We used a five-point scale ranging from “not important” to “important.” Even with identification purposes being the most relevant argument for collar use in our study, the average cat owner still only rated identification as “partly unimportant/partly important” (score 3 from the five-point scale). The second most

important reason was the increasing visibility of the cat. However, to date, evidence is lacking that reflective collars or lights attached to collars do indeed reduce the risk of being involved in a traffic accident (Rochlitz, 2003). In our sample of 1342 central European cat owners, reduction of predation was one of the least important reasons for collar use compared to the sample of 393 New Zealand cat owners. They rated reduction of predation as the second and third most common reason to fit a collar (birds about 20%; other animals about 10%). In our study, less than 1% of owners reported the use of antipredation devices such as the BirdBesafer® collars. Twenty percent reported to often use a bell attached to their cat's collar, similar to reports of UK cat owners (Thomas et al., 2012). Many collars come preassembled with bells; therefore, the use of a bell might be a less active decision compared to the use of a specific antipredation device such as the BirdBesafer® collar. The use of antipredation devices might be highly dependent on region and generally quite uncommon in Central Europe. The underlying cause could be found in cultural differences between regions, different attitudes toward cats as potential predators, and differences in legislation and campaigns for bird and wildlife protection (Crowley et al., 2020; Trouwborst et al., 2020).

Collar users and noncollar users did not differ in the number of sources they used for information about cat husbandry, that is, how to manage and care for their cat. The most relevant sources of information about cat collars were the internet, the veterinarian, and

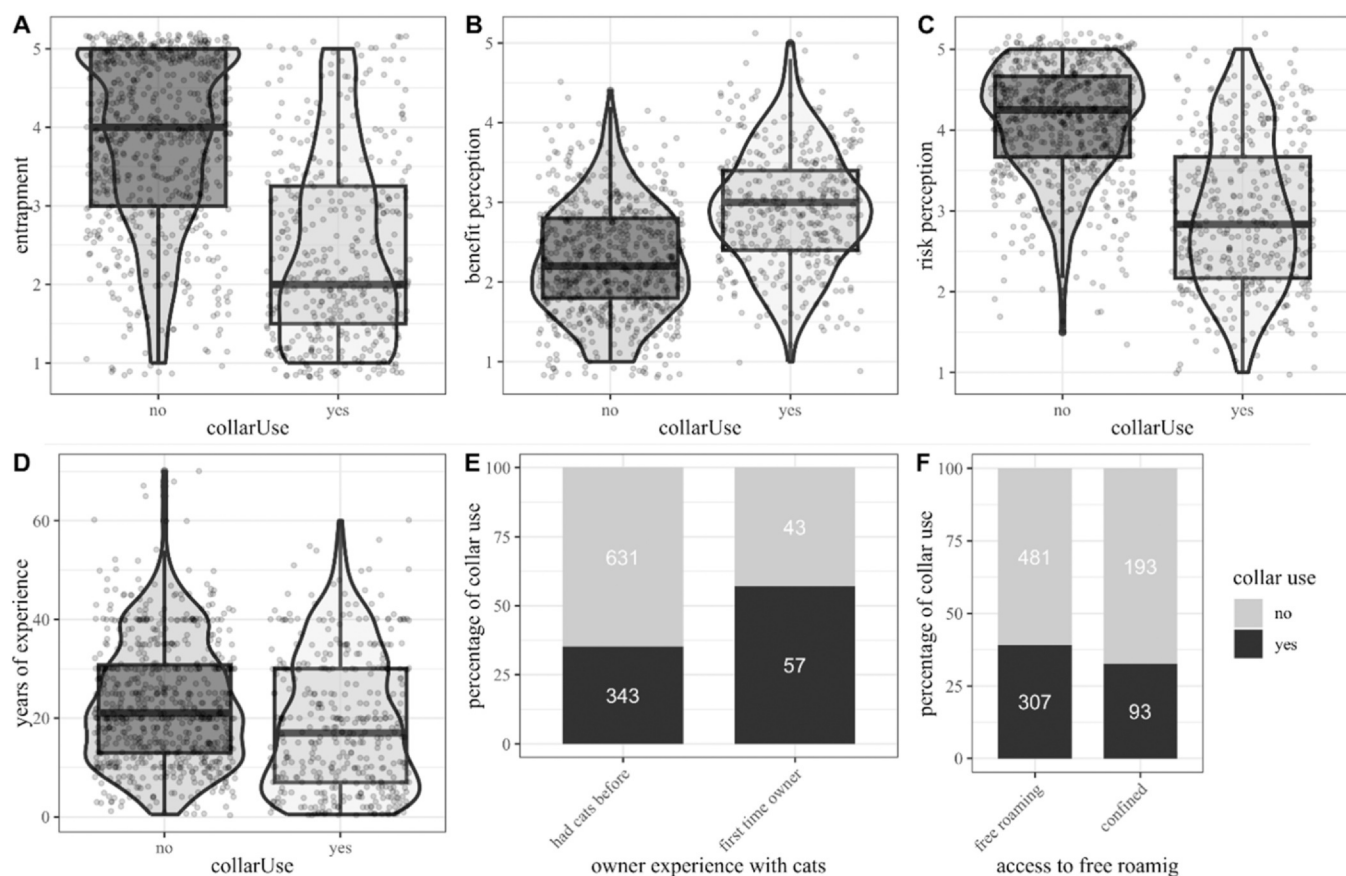


Figure 2. Factors relevant for collar use in past 2 years ($N = 1074$) illustrated in boxplots and violin plots or bar plots. A) Agreement to problems with entrapment split by collar use rated on a five-point scale. B) Benefit and C) risk perception toward collars rated on a five-point scale split by collar use. The subscales benefit and risk perception and entrapment were calculated following a principal component analysis. Subscales scores were obtained by calculating the mean of the items in each subscale. D) Duration (years) of cat ownership split by collar use. E) Percentage of collar use by owner experience. F) Percentage of collar use in free-roaming cats. Noncollar users are marked in gray and collar users in black. The number of case reports contributing to each category is indicated as N in white.

pet shops. Collar users are more often reported to use pet shops as a source of general information on cat ownership. This highlights that pet shops should have trained staff and provide accurate information to customers regarding the safety and correct use of pet equipment. Additionally, leaflets with recommendations on how to fit a collar, how to train a cat to tolerate a collar, and how to reduce risks in long-term collar use should be provided.

Most often collars were reportedly made of partly or fully elastic materials. This is believed to be associated with an increased risk of getting entrapped on an object and, therefore, not recommended (for review, see Arhant et al., 2022a). Lord et al. (2010) tested the safety of three collar types and found that the three cats that got entrapped on an object wore elastic “safety collars.” Further, 60% of the elastic collars were frayed and therefore at risk of loosening within the study period of 6 months. Whether elastic collars in long-term use are riskier to cats remains to be tested. To err on the side of caution, it is recommended that elastic collars should be avoided (ICC, 2018).

About one-fifth of owners reported use of nonbreakaway buckles. However, the most common buckles were different types of breakaway buckles. This is in accordance with recommendations on collar use (Lord et al., 2010; Calver et al., 2013; Arhant et al., 2022a). We assumed that having sought information on collars prior to use would increase the use of breakaway buckles; however, our results did not confirm this assumption.

Collar loss is more common when breakaway buckles are used (Lord et al., 2010). In long-term use, about half of our participants reported no loss of their cat's collar within a period of three months,

and about 40% stated that their cat lost its collar one to three times. Lord et al. (2010) report about 50% loss of breakaway buckle collars within 6 months. Repeated loss of collars and associated costs are aspects that have been made responsible for the low use of collars in cats. Collar loss was the most commonly mentioned reason (30% of owners) for not using collars in New Zealand (Harrod et al., 2016). In this study, the type of collar was not specified. In the UK, 28% of owners did not replace a lost collar (Thomas et al., 2012). This highly contrasts with our results where collar loss was one of the least frequently mentioned reasons for rejection of collar use. In ours, as well as in the Harrods study, financial expense was least often reported to lead to not using collars. However, anecdotally, owners often complain about the loss of (expensive breakaway) collars when the topic collar use in cats is addressed, for example, during a veterinary visit. Social desirability bias (Fisher and Katz, 2000) might have led to the rejection of cost as a reason for not using collars in both surveys.

Tracking devices were rarely used by cat owners. Only 6% (radio-frequency) and 7% (GPS) reported that they always use a tracking device on their cat's collar. Although tracking devices have been successfully used in scientific studies (Horn et al., 2011; Wierzbowska et al., 2012; Pisanu et al., 2020), it is unclear how well the average cat owner can use this type of equipment, which requires at least basic technical knowledge and skills. We have been able to show that some lost cats have been successfully retraced by cat owners with the help of a tracking device (Arhant et al., 2022b). The use of nonbreakaway collars with tracking devices can lead to severe incidents (Subacz, 2008). Mounting tracking equipment on breakaway collars led to loss

of the equipment in a fifth of cats, two thirds could be retrieved and replaced (Hanmer et al., 2017). A lost collar may be retrieved by locating it with the tracker, but this procedure is likely time-consuming, not always successful and may be annoying to owners if occurring frequently. Some suggested the use of harnesses with tracking devices (Klune et al., 2021). However, the safety of harnesses remains unexplored. The suggestion that entrapment incidents involving serious injury could be reduced by the use of tracking devices is based on the ability of the user to recognize and react to an unusual event. In the case of entrapment resulting in strangulation, the time frame for rescue may be too short. Therefore, it remains unclear whether the use of a tracking device increases the safety of collar use. This clearly warrants further investigation.

Some cats react negatively when fitted with a collar: many scratch at the neck damaging their fur or skin, attempt to remove the collar with their paws and get tangled while trying to remove it, or may flee in panic (for review, see Arhant et al., 2022a), which can lead to a traffic accident in the worst case scenario (Hall et al., 2015). Our data showed that collar users view risks from entrapment as more relevant than damage to fur/skin in their decision-making progress as to whether they want to continue using a collar.

Training has been suggested as a method to increase acceptance and reduce risks (Arhant et al., 2022a). We aimed to get the first insights into this topic. Around 300 participants reported on their process of first-time fitting. Assessed through the options provided, a quarter of respondents reported that they used repeated fastening of the collar to get their cat used to it. One-fifth of participants reported positive reinforcement with treats as part of their habituation process. Both cats with and without habituation to collars showed behavioral changes after being fitted with collars. Contrary to what we expected, on a descriptive level, changes in behavior were more commonly reported in cats that underwent habituation. The following are possible reasons: First, cat owners who report habituation may have done so in response to the cat's initial intolerance of the collar. Second, cat owners who actively chose to habituate their cats to the collar may have been more aware of the potential risks and may have observed their cats more closely as a result, noticing more subtle changes. Third, there may have been a misunderstanding of the wording of the question. In particular, the high number of habituated cats that showed less scratching of the collar area during the first 2 weeks of wearing the collar led us to believe that some participants may have reported differences in behavior between the beginning and end of the habituation period, rather than between the cat not wearing the collar and the cat wearing the collar. Therefore, we refrained from testing for significant differences and want to view these results with caution. Nevertheless, this aspect warrants further investigation. It would be ideal to conduct a study that compares different types of habituation/training processes associated with accustoming cats to collars, including behavioral observations before, during, and after the introduction of the collar, to investigate if collar training increases tolerance and reduces the risks associated with collars.

Owners using cat collars were older, perceived a lower risk and higher benefits in cat collar use, and allowed free roaming. A factor associated with the decision to refrain from collar use included working with cats, for example, in a shelter or veterinary practice. Professionals working with cats might have been confronted with more reports of incidences than the average cat owner. Owner experience led to contrasting results regarding lifetime use or recent use within the past 2 years. For lifetime use, more experience with cats and not being a first-time owner increased the likelihood of having used a collar on one of their cats. In contrast, owners who reported collar use in the past 2 years had less experience and were more often first-time owners. This suggests that owners are willing to try collars but do not continue to use them over time as they may not see the expected benefit.

Regarding further limitations of our study, we point out that this analysis is based on a self-selected sample of central European, German-speaking, mainly female (89%) cat owners answering an online questionnaire. A predominance of female respondents was also found in other questionnaire studies on cats (Toukhsati et al., 2007; Gunaseelan et al., 2013; Windschnurer et al., 2022), where females comprised 71%, 84%, and 74% of the sample. There seems to be a higher likelihood for women to respond to surveys on pet animals, for example, dogs (Arhant et al., 2010), rabbits (Rooney et al., 2014), and ferrets (Köbrunner et al., 2020). On the other hand, it could also reflect a trend that women tend to be the main caretaker in cat households (Windschnurer et al., 2022). The present sample may not represent cat owners in other countries due to the survey being available in German only. Therefore, a translation of the questionnaire into other languages and data collection in other regions would be desirable. Since the participation in the study was voluntary, it cannot be ruled out that more engaged and motivated owners or those who had bad experiences with collars were more likely to participate. To counteract this potential sampling bias, we advertised for the questionnaire in a very neutral presentation regarding husbandry as a whole.

Another limitation inherent to this type of study is that subjectivity regarding scales and interpretation of animal behavior cannot be excluded. For instance, the findings could be biased to some degree by what owners perceived as “seldom,” “sometimes,” or “often.” However, owner assessments are very valuable data despite criticism regarding their validation (Christiansen and Forkman, 2007). Since owners are in daily contact with their animals, they know best about their animals' behaviors and changes in behavior. Moreover, there is the possibility of a subjective bias: Self-description of human behavior can be biased due to different factors such as reduced memory or over-reporting behaviors because of socially desirable responding (for review, see Kormos and Gifford, 2014). Advantages of self-reports are that they allow flexibility, are low cost, and make it possible to study behaviors that cannot be easily observed otherwise (Kormos and Gifford, 2014).

Another point of criticism could be the varying sample sizes because we refrained from using a forced answering option. Although this comes with the disadvantage of fluctuating sample sizes, it decreases the risk of complete dropout of participants and improves the quality of the answers (Décieux et al., 2015). Finally, as inherent to epidemiological approaches, we tested for significant associations that were based on assumptions. Thus, due to the nature of the study, we cannot draw conclusions on causal relationships but only on associations.

Conclusion

Many cat owners believe that collars are unsafe and either do not use them at all or only on a trial basis. Especially in free-roaming cats, collars increase the likelihood of identification, yet the perceived risk, albeit small, presents an issue. To increase collar use, we suggest that it would be necessary to further reduce the risks of collar use by developing safer collars and by reducing cost associated with loss and replacement (e.g., by developing paper collars that are safe and cheap). Further, benefits from collar use, such as identification, tracking, better visibility, or reduction of predation, need to be highlighted to owners. Only when the benefits outweigh the risks will collar use in cats be more widely accepted.

Authorship Statement

The study was designed by C. Arhant, R. Lesch, V. Heizmann, G. Schauburger, and I. Windschnurer. The questionnaire was developed by C. Arhant, V. Heizmann, and I. Windschnurer. The analyses were carried out by C. Arhant and R. Lesch. The manuscript was drafted by

C. Arhant, R. Lesch, and I. Windschnurer. It was revised and critically discussed by C. Arhant, R. Lesch, V. Heizmann, G. Schaubberger, and I. Windschnurer. The final version was approved by all authors.

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Ethical Considerations

All procedures applied during the course of this study were discussed with the institutional ethics committee (of the Veterinary University of Vienna) as well as the ethics committee of the University of Medicine, Vienna. These committees also confirmed that no ethics vote was necessary, in accordance with guidelines for Good Scientific Practice and with Austrian national legislation.

Conflict of Interest

The present study was co-funded by TASSO e.V. (<http://www.tasso.net>). TASSO e.V. was involved in the preparation and advertisement of the questionnaire but did not influence analyses and interpretation of the results. The text represents the authors' views and does not necessarily represent the position of TASSO e.V., who will not be liable for the use of such information.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.jveb.2024.06.004](https://doi.org/10.1016/j.jveb.2024.06.004).

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