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# Pharmacological treatment of canine and feline undesirable behaviors by Finnish veterinarians

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## ABSTRACT

Undesirable behaviors of dogs and cats may reduce their quality of life and may cause harm to their owners. Such behaviors have been treated with medications as well as behavioral training and environmental modifications. Finnish veterinarians answered a web-based questionnaire to characterize the treatment of undesirable behaviors in dogs and cats by medications. Fourteen indications related to undesirable behaviors were defined in the questionnaire. Most psychoactive medications authorized for veterinary or human use in Finland and allowed to be prescribed for animal use according to the national legislation were listed. In addition, some sedative and analgesic agents were included. Canine and feline undesirable behaviors were treated by the respondents with a wide variety of medications. In many cases, none of the remedies used could be demonstrated to be a clear favorite for a certain indication. Off-label use of psychoactive medications was common. Many medications were used without research-based evidence of their efficacy for the indication in those species in question. Treatment of dogs was more often associated with advice for behavioral training in addition to medications than treatment of cats. Both the common off-label use of medications and the wide variety of substances used for the particular behavioral problem reveal the need for further clinical evidence of the efficacy of medications to treat various canine and feline undesirable behaviors.

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## Introduction

Animal welfare, including physiological and psychological aspects, has become an important issue in society. At the same time, pet animals living in the home have gained the position of family members (Walsh, 2009; Bouma et al., 2021). The new stance may benefit pets, but it also includes a strong demand for them to adjust to human life with its pros and cons. Many city-based dog owners only take their pets out for a walk on leash in crowded streets. It is also desirable that dogs behave acceptably without making unnecessary noise, such as barking. If the owner lives in an apartment building, the dog must learn how to live within four walls without disturbing the life of neighbors. As for cats, they may meet such stressors as inter-cat conflicts and the inability to perform highly motivated behavior patterns when kept indoors (Amat et al., 2016). Furthermore, dogs and cats are social species, but as members of

human families, many of them must learn to spend several hours alone at home.

Undesirable behaviors are common in pet animals (Golden and Hanlon, 2018; Salonen et al., 2020; Yamada et al., 2020), and they are probably the major reason why young and healthy dogs and cats are relinquished or euthanized (Boyd et al., 2018; Pegram et al., 2021). In addition to harm for the owner, not coping with the environment worsens the quality of life of the animal in many ways. Thus, behavioral queries are very common in small animal practice nowadays (Golden and Hanlon, 2018). Undesirable behaviors in pet animals have been treated with pharmacological approaches, behavioral and environmental modifications, or their combinations (Overall, 2019). In data from primary-care veterinary practices in the UK, the most common undesirable behaviors for which medications were prescribed comprised anxiety/distress and aggression (Craven et al., 2022). Despite the extent of behavioral concerns in veterinary practice, many veterinary graduates may lack competence in behavioral veterinary medicine due to the limited amount of training in this area (Golden and Hanlon, 2018; Overall, 2019; Kogan et al., 2020; Hevern, 2022).

Only a few veterinary medicinal products have been authorized for treating undesirable behaviors in dogs, and even fewer in cats in

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Finland. According to the European Union regulations, if there is no authorized veterinary medicinal product for a condition, the veterinarian may treat the dog or cat with a veterinary medicinal product authorized for use in another animal species or for another condition, and if there is no such product, with a medicinal product authorized for human use (Directive 2004/28/EC).

The primary aim of the questionnaire survey was to describe the use of psychologically active medications affecting the central nervous system, particularly for undesirable behaviors in dogs and cats, as well as advice given for behavioral training and management in addition to or instead of medication. Since some of the same medications are used to treat epilepsy or alleviate pain, use for these indications was also enquired. We were also interested whether individual veterinarians treat cats differently from dogs. We hypothesized that off-label use of drugs affecting the central nervous system for undesirable behaviors is common and that dog owners may more often receive advice for behavioral training and management than cat owners.

## Methods

An internet questionnaire was piloted between May and June 2018 by six small animal general practitioners recruited from the employees of the Helsinki University Veterinary Teaching Hospital. Three of the respondents filled in the questionnaire alone, and the other three while the researcher was present. The latter three respondents were asked to think aloud while filling in the questionnaire; the events were recorded and the researcher kept notes. The questionnaire was modified based on the feedback and the ambiguities noted during the pilot study.

The final questionnaire (Supplementary material) consisted of background information of the respondent (gender, year of graduation, type of practice), and questions about the use of 14 named medications or groups of medicines for 17 defined indications in dogs and cats, respectively. Most psychoactive medications authorized for veterinary or human use in Finland and allowed to be prescribed for animal use according to the national legislation were included (amantadine, benzodiazepines, buspirone, clomipramine, fluoxetine, gabapentin, monoamine oxidase [MAO] inhibitors, mirtazapine, pregabalin, tricyclic antidepressants). In addition, some common sedative and analgesic agents were listed (butorphanol, dexmedetomidine, fentanyl patch, tramadol). An open text box was provided after each medicine for additional indications. Whether veterinarians gave advice for behavioral training and management in addition to or instead of medications was also queried.

Data were gathered during the years 2018 and 2019. Initially, the questionnaire was available online. It was advertised in a national Facebook group for veterinarians and via e-mails to employees of a large chain of veterinary clinics. Since this yielded only 62 responders, more answers were collected during two national veterinary congresses, where the researcher personally asked veterinarians to fill in the questionnaire using a laptop or a table computer. This provided 20 additional responders. A link to the questionnaire was also distributed in the latter congress, and a further three veterinarians filled in the questionnaire. Due to the data organization as ordinal variables, non-parametric statistical testing was utilized. Differences in the frequency of use of each drug by each veterinarian were compared between dogs and cats using related-samples Wilcoxon signed-rank test. The differences between dogs and cats in the veterinarian giving advice for behavioral training and management in addition to or instead of drugs were evaluated using related-samples McNemar test. Data were analyzed using IBM SPSS Statistics for Windows, version 25 (IBM Corp., Armonk, NY, USA), and  $P < 0.05$  was utilized as a significance threshold. The 95% confidence intervals (CIs) were calculated for the proportions using the formula  $1.96 \cdot \sqrt{[p(1-p)/n]}$ , where  $p$  is the proportion in decimal form and  $n$  is the sample size. They were used to evaluate the statistical differences between indications and between medications (Nakagawa and Cuthill, 2007). If the CIs did not overlap, it was presumed to indicate a statistically significant difference.

## Results

Data collected with and without the researcher being present were compared. Since no significant differences were detected in year of graduation ( $P = 0.191$ , independent samples Mann-Whitney U test), gender ( $P = 0.702$ , Pearson chi-square test), or type of practice ( $P = 0.276$ , Pearson chi-square test) between these groups, the data of these two different data collections were pooled. Of the 84 respondents, 72 were women and 12 men. They had graduated between 1977 and 2019 (median 2009). A total of 59 respondents stated that they maintained only small animal practice, nine mainly small animal practice, 13 mixed practice containing equally large and small animals, two mainly large animal practice, and one mainly something other than practice.

Dexmedetomidine, gabapentin, pregabalin, clomipramine, fentanyl patch, and tramadol were used more frequently in dogs than in cats, whereas fluoxetine and mirtazapine were used more frequently in cats (Table 1). In general, the most commonly mentioned indication for the use of the medications included acute pain in both

**Table 1**  
Frequency of use of each medicinal substance in dogs and cats ( $n = 84$ ) and  $P$ -values for differences between species.

Frequency	Dogs							Cats							P-value
	0	1	2	3	4	5	6	0	1	2	3	4	5	6	
Amantadine	0	66	10	5	3	0	0	0	81	2	1	0	0	0	<0.001 <sup>a</sup>
Benzodiazepines	1	6	5	17	8	20	27	1	15	3	9	9	18	29	0.323
Buspirone	0	83	0	0	1	0	0	0	84	0	0	0	0	0	0.317
Butorphanol	0	11	0	2	1	2	68	0	12	1	1	2	4	64	0.044
Clomipramine	0	26	24	25	6	3	0	1	72	7	4	0	0	0	<0.001 <sup>a</sup>
Dexmedetomidine	0	4	7	28	6	6	33	0	42	5	4	2	4	27	<0.001 <sup>a</sup>
Fentanyl patch	0	47	7	10	2	9	9	1	55	4	9	6	5	4	0.001 <sup>a</sup>
Fluoxetine	1	76	4	1	1	1	0	0	65	5	9	4	1	0	<0.001 <sup>a</sup>
Gabapentin	0	9	3	14	8	32	18	1	33	7	14	10	15	4	<0.001 <sup>a</sup>
MAO inhibitors	2	69	9	4	0	0	0	1	76	5	1	1	0	0	0.270
Mirtazapine	1	53	9	10	3	5	3	1	13	6	17	12	24	11	<0.001 <sup>a</sup>
Pregabalin	2	74	5	2	0	0	1	4	79	0	0	0	1	0	0.003 <sup>a</sup>
Tramadol	0	6	3	11	20	22	22	0	19	7	12	13	23	10	<0.001 <sup>a</sup>
Tricyclic antidepressants	1	63	10	5	4	0	1	2	60	8	12	2	0	0	0.908

MAO = monoamine oxidase.

Frequency: 0 = cannot say; 1 = never; 2 = once a year or more rarely; 3 = a few times a year; 4 = once within 2 months; 5 = monthly; 6 = weekly.

<sup>a</sup> Statistically significant difference at  $P < 0.05$  between species when Bonferroni correction was used.

**Table 2**  
Indications for the use of medications affecting the central nervous system for treatment of canine undesirable behaviors.

	Dogs			Cats		
	Acute pain	Chronic pain	Epilepsy	Acute pain	Chronic pain	Epilepsy
Amantadine	1 (0-3)	21 (12-30)	0	0	4 (0-8)	0
Benzodiazepines	11 (4-18)	1 (0-3)	55 (44-66)	10 (4-16)	2 (0-5)	31 (21-41)
Buspirone	0	0	0	0	0	0
Butorphanol	51 (40-62)	6 (1-11)	2 (0-5)	51 (40-62)	7 (2-12)	1 (0-3)
Clomipramine	0	0	0	0	0	0
Dexmedetomidine	17 (9-26)	1 (0-3)	6 (1-11)	12 (5-19)	2 (0-5)	2 (0-5)
Fentanyl patch	43 (32-54)	6 (1-11)	0	31 (21-41)	5 (0-10)	0
Fluoxetine	0	0	0	0	1 (0-3)	0
Gabapentin	13 (6-20)	87 (80-94)	1 (0-3)	10 (4-16)	57 (46-68)	0
MAO inhibitors	0	0	0	0	0	0
Mirtazapine	0	0	0	4 (0-8)	0	1 (0-3)
Pregabalin	0	5 (0-10)	2 (0-5)	0	1 (0-3)	0
Tramadol	90 (84-96)	37 (26-46)	0	73 (64-82)	1 (0-3)	0
Tricyclic antidepressants	0	13 (6-20)	0	0	21 (12-30)	0
At least one of the drugs used for the indication	98 (95-100)	92 (86-98)	58 (47-69)	88 (81-95)	67 (57-77)	31 (21-41)

MAO = monoamine oxidase.

The frequencies are expressed as proportions (%) of all respondents (n = 84). Confidence intervals (95%) are presented in parentheses for the proportions.

dogs and cats. Opioids and tramadol were the most commonly used of these medications (Table 2).

Noise aversion, phobias, separation anxiety, and other anxieties were the most common indications for pharmacological treatment of canine undesirable behavior (Table 3). For indications related to undesirable behavior, dexmedetomidine and clomipramine were the most often reported medications in dogs, both of which were used for several indications. In cats, mirtazapine and benzodiazepines were the most widely used medications for behavioral concerns, and anorexia was the most common indication for their use (Table 4). Most veterinarians reported that they give advice for behavioral training and management in addition to (51%, CI 40%-62%) and/or instead of (68%, CI 58%-78%) pharmacological approaches to treat both canine and feline undesirable behavior, but dog owners more often than cat owners received advice for behavioral training in addition to pharmacological treatment (Table 5). A total of 70% (CI 60%-80%) of the respondents had given advice to dog owners in addition to medication and 79% (CI 70%-88%) of them instead of medication.

## Discussion

A wide variety of medications were used by the respondents for alleviating canine and feline undesirable behaviors. However, in many cases, none of the remedies used was demonstrated to be a clear favorite for a certain indication. For example, anxieties were common concerns in both dogs and cats, but no specific drug of choice was used by most veterinarians for other anxieties than separation anxiety in dogs, which was most often treated with clomipramine. Feline urine soiling was also a common problem treated with diverse medications, suggesting that a specific efficacious cure was not known for this problem. Furthermore, this may reflect the diverse causes of urine soiling in cats.

Unfortunately, the questionnaire did not distinguish between a prescription of a medicine and a veterinarian-administered medicine. Therefore, some respondents also appeared to have described the perioperative and emergency use of medicines. Thus, the data on the use of sedative and analgesic agents for the treatment of pain and epilepsy should be interpreted with caution, and these indications are not discussed further here. However, presumably, the pharmacological treatments for the main indications examined in this study, that is, undesirable behaviors, were usually carried out with medicines prescribed by the veterinarian and administered by the owner.

Dexmedetomidine was one of the most frequently used medications to treat undesirable behaviors in dogs, particularly noise aversion. As an injectable product, this alpha2-adrenoceptor agonist is widely used for sedation in many species. The oral gel has been approved by the European Medicines Agency (EMA) and the US Food and Drug Administration (FDA) to treat noise aversion in dogs. Dexmedetomidine was also often used to alleviate other phobias and anxiety in both dogs and cats. However, the oral gel is presumably not efficient in treating long-term problems due to its relatively short half-life, but its administration in series of noise events has been reported (Gruen et al., 2020). Furthermore, research-based evidence can only be found for its efficacy in fear and anxiety in dogs during veterinary visits (Korpivaara et al., 2021) in addition to the labeled indications (Korpivaara et al., 2017; Gruen et al., 2020).

Clomipramine was the most frequently used medication for canine separation anxiety, and it was also used for other anxieties and obsessive-compulsive disorder (OCD)/stereotypy. In cats, it was only used occasionally, mainly for anxiety, urinating problems, and OCD/stereotypy. Clomipramine is a tricyclic antidepressant that prevents the reuptake of serotonin and noradrenaline. It has been labeled for canine separation anxiety by the US FDA and the EMA. In Canada, it is approved for both separation anxiety and OCD/stereotypies. In dogs, its efficacy has been demonstrated in clinical trials for separation anxiety (King et al., 2000; Seksel and Lindeman, 2001; Cannas et al., 2014) and OCD (Hewson et al., 1998; Overall and Dunham, 2002). A few publications have also suggested its action in other types of anxieties (Seksell and Lindeman, 2001; Frank et al., 2006) as well as in tail chasing (Moon-Fanelli and Dodman, 1998; Yalcin, 2010) and "dominance-related aggression" (impulse control/conflict aggression) (White et al., 1999). In cats, clomipramine reduces the frequency of urine soiling (King et al., 2004; Hart et al., 2005; Landsberg and Wilson, 2005; Mills et al., 2011). It was also reported to be effective in controlling the signs of anxiety-related disorders and OCD in a small group of cats (Seksell and Lindeman, 1998) but failed to alleviate the signs of psychogenic alopecia (Mertens et al., 2006).

Of other tricyclic antidepressants, amitriptyline and its active metabolite nortriptyline are labeled for human use, in whom they induce sedation, anticholinergic activity, and antipruritic action and modify neuropathic pain. Furthermore, they are used for behavior disorders. In the present study, apart from the alleviation of chronic pain, they were used for occasional other indications in dogs. In cats, they were also used for aggression and urine soiling. Amitriptyline has been used for the treatment of feline idiopathic urinary tract problems (Chew et al., 1998; Kraijer et al., 2003; Kruger et al., 2003),

**Table 3** Indications for the use of medications affecting the central nervous system to treat canine undesirable behaviors.

	Aggression	Anorexia	Dementia	Depression	Grooming problems	Impulsivity	Noise aversion	Phobias	Separation anxiety	Other anxieties	Stereotypy and OCD	Urine soiling	Used for at least one indication
Amantadine	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzodiazepines	5 (0-10)	6 (1-11)	0	0	0	1 (0-3)	5	14 (7-21)	0	12 (5-19)	0	7 (2-12)	31 (22-40)
Bupirone	0	0	0	0	0	0	0	0	0	0	0	0	0
Butorphanol	5 (0-10)	1 (0-3)	0	0	0	0	0	5 (0-10)	0	19 (11-27)	0	0	24 (15-33)
Clomipramine	2 (0-5)	0	0	0	2 (0-5)	5 (0-10)	4 (0-8)	16 (8-24)	56 (45-67)	24 (15-34)	11 (4-18)	1 (0-3)	63 (53-73)
Dexmedetomidine	7 (2-12)	0	0	0	0	1 (0-3)	60 (50-70)	49 (38-60)	1 (0-3)	16 (8-24)	2 (0-5)	0	70 (60-80)
Fentanyl patch	0	0	0	0	0	0	0	0	0	0	0	0	0
Fluoxetine	0	0	1 (0-3)	1 (0-3)	0	4 (0-8)	0	2 (0-5)	4 (0-8)	2 (0-5)	5 (0-10)	0	6 (1-11)
Gabapentin	1 (0-3)	0	0	0	0	1 (0-3)	0	1 (0-3)	1 (0-3)	1 (0-3)	1 (0-3)	0	4 (0-8)
MAO inhibitors	0	0	7 (2-12)	0	0	0	0	0	0	2 (0-5)	1 (0-3)	0	8 (2-14)
Mirtazapine	0	20 (11-29)	0	0	0	0	0	0	0	0	0	1 (0-3)	21 (12-30)
Pregabalin	0	0	0	0	0	0	0	0	0	0	0	0	0
Tramadol	0	0	0	0	0	0	0	0	0	0	1 (0-3)	0	1 (0-3)
Tricyclic antidepressants	1 (0-3)	0	0	1 (0-3)	2 (0-5)	1 (0-3)	0	2 (0-5)	2 (0-5)	2 (0-5)	4 (0-8)	4 (0-8)	7 (2-12)
At least one of the drugs used for the indication	14 (7-21)	25 (16-34)	8 (2-14)	2 (0-5)	4 (0-8)	10 (4-16)	62 (52-72)	63 (53-73)	56 (45-66)	48 (37-59)	17 (9-25)	12 (5-19)	92 (86-98)

MAO = monoamine oxidase; OCD = obsessive-compulsive disorder.

The frequencies are expressed as proportions (%) of all respondents (n = 84). Confidence intervals (95%) are presented in parentheses for the proportions. The proportions of respondents using each medicinal substance for at least one behavioral indication are presented in the last column, and the proportion of respondents using at least one of the listed medications for each indication is presented in the bottom line. No respondent reported the use of medications for problems related to oral or sexual behavior in dogs.

**Table 4** Indications for use of medications affecting the central nervous system to treat feline undesirable behaviors.

	Aggression	Anorexia	Dementia	Depression	Grooming problems	Impulsivity	Noise aversion	Phobias	Separation anxiety	Other anxieties	Sexual behavior	Stereotypy and OCD	Urine soiling	Used for at least one indication
Amantadine	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzodiazepines	0	39 (29-49)	0	0	0	0	1 (0-3)	5 (0-10)	0	16 (8-24)	0	0	8 (2-14)	49 (38-60)
Bupirone	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Butorphanol	5 (0-10)	2 (0-5)	0	0	0	0	1 (0-3)	2 (0-5)	0	19 (11-27)	0	0	5 (0-10)	29 (19-39)
Clomipramine	1 (0-3)	0	0	1 (0-3)	1 (0-3)	1 (0-3)	0	1 (0-3)	1 (0-3)	5 (0-10)	0	5 (0-10)	10 (4-16)	
Dexmedetomidine	0	0	0	0	1 (0-3)	0	7 (2-12)	17 (9-25)	0	11 (4-18)	0	0	1 (0-3)	24 (15-34)
Fentanyl patch	4 (0-8)	0	0	0	0	0	0	0	0	0	0	0	1 (0-3)	5 (0-10)
Fluoxetine	5 (0-10)	0	0	1 (0-3)	2 (0-5)	2 (0-5)	0	4 (0-8)	0	7 (2-12)	0	8 (2-14)	19 (11-27)	21 (12-30)
Gabapentin	2 (0-5)	0	0	0	0	1 (0-3)	1 (0-3)	4 (0-8)	0	7 (2-12)	0	1 (0-3)	0	11 (4-18)
MAO inhibitors	1 (0-3)	0	2 (0-5)	1 (0-3)	0	0	0	0	0	1 (0-3)	0	1 (0-3)	4 (0-8)	6 (1-11)
Mirtazapine	0	74 (65-83)	0	5 (0-10)	0	0	0	1 (0-3)	0	1 (0-3)	0	0	2 (0-5)	75 (66-84)
Pregabalin	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tramadol	1 (0-3)	0	0	0	0	0	0	0	0	0	0	0	2 (0-5)	5 (0-10)
Tricyclic antidepressants	10 (4-16)	0	0	1 (0-3)	4 (0-8)	0	1 (0-3)	1 (0-3)	1 (0-3)	1 (0-3)	1 (0-3)	2 (0-5)	17 (9-25)	18 (10-26)
At least one of the drugs used for the indication	19 (11-27)	75 (66-84)	2 (0-5)	8 (2-14)	8 (2-14)	5 (0-10)	11 (4-18)	26 (17-35)	2 (0-5)	38 (28-48)	1 (0-3)	13 (6-20)	41 (30-52)	81 (73-89)

MAO = monoamine oxidase; OCD = obsessive-compulsive disorder.

The frequencies are expressed as proportions (%) of all respondents (n = 84). Confidence intervals (95%) are presented in parentheses for the proportions. The proportions of respondents using each medicinal substance for at least one behavioral indication are presented in the last column, and the proportion of respondents using at least one of the listed medications for each indication is presented in the bottom line. No respondent reported the use of medications for problems related to oral behavior in cats.

**Table 5**

Veterinarian had given advice for behavioral training and management in addition to or instead of medications in dogs and cats and the *P*-value for difference between species.

	Yes, both	Yes, dogs only	Yes, cats only	Neither	<i>P</i> -value
In addition	43	16	2	23	0.001
Instead	57	9	4	14	0.267

Values are given as the number of respondents (total *n* = 84).

and thus it may also alleviate urinary soiling associated with them. No research-based evidence could be found for the efficacy of tricyclic antidepressants in aggression in cats. On the contrary, no benefit could be demonstrated in treating aggression among cats with amitriptyline (Lindell et al., 1997). Furthermore, adjunctive amitriptyline was not demonstrated to be more effective than behavior modification alone for the clinical management of aggressive behaviors in dogs (Virga et al., 2001). Moreover, clomipramine has been shown to be more efficacious than amitriptyline for the treatment of canine OCD (Overall and Dunham, 2002).

Fluoxetine specifically inhibits serotonin reuptake. This antidepressant has been approved by the EMA and the FDA for the treatment of separation anxiety in dogs. Moreover, it may be efficacious in the treatment of canine OCD (Irimajiri et al., 2009). However, in the present survey, its use in dogs was rather rare. This result is inconsistent with an earlier survey reporting that fluoxetine was commonly prescribed to dogs by veterinarians practicing in North America, particularly for anxieties (Kaur et al., 2016). The veterinary fluoxetine product had no distributor in Finland at the time that this survey was carried out. Therefore, human-labeled products were probably used, or the veterinary product may have been prescribed or sold after applying for a special license (Directive 2004/28/EC). This may have reduced the use of fluoxetine reported in this survey compared with, for example, clomipramine. In our study, fluoxetine was more commonly used in cats than in dogs, particularly for urinating problems. Unwanted elimination behaviors were also the most common indication for prescribing fluoxetine in cats in North America (Kaur et al., 2016). Fluoxetine has been shown to markedly reduce the rate of feline urine marking (Pryor et al., 2001), with an efficacy similar to clomipramine (Hart et al., 2005; Mills et al., 2011).

Mirtazapine was the most frequently used medication for both canine and feline anorexia, and it was only occasionally used for other indications. It is a noradrenergic and specific serotonergic antidepressant (Anttila and Leinonen, 2001). Mirtazapine has been approved by the EMA for body weight gain in cats experiencing poor appetite and weight loss resulting from chronic medical conditions. By US FDA, it has been approved for the management of unintended weight loss in cats. Mirtazapine has been shown to improve appetite and induce weight gain in cats with weight loss (Quimby and Lunn, 2013; Poole et al., 2019). In experimental dogs, it accelerated gastric emptying and colon transit (Yin et al., 2014). No research-based evidence was available for its efficacy in alleviating canine anorexia at the time the survey was carried out. However, a recent study suggested that mirtazapine could be beneficial to replace fluoxetine for appetite enhancement in combination with paroxetine (Richter and Martin, 2024).

Apart from epilepsy and perioperative use, benzodiazepines were used for a variety of undesirable behaviors in both dogs and cats, particularly anorexia in cats and phobias and anxiety in both species. However, their use for the stimulation of appetite is no longer recommended due to a lack of evidence for their efficacy (Agnew and Korman, 2014). Moreover, diazepam has been associated with hepatic failure in cats (Center et al., 1996; Hughes et al., 1996; Agnew and Korman, 2014). In dogs, diazepam may sometimes alleviate anxiety-related undesirable behaviors, but lack of efficacy and side

effects, such as sedation, ataxia, agitation, and aggression, were common (Herron et al., 2008). Of other benzodiazepines, the effects of alprazolam have been studied for the treatment of storm phobia in dogs (Crowell-Davis et al., 2018), and it may also have been used for that or other indications where the use of benzodiazepines was reported in the present study. However, it should be considered whether more effective, specific, and safer alternatives exist before prescribing benzodiazepines for undesirable behaviors.

Gabapentin and pregabalin reduce calcium influx. They have anticonvulsant, antiepileptic, and anxiolytic effects, but they are also used for alleviation of neuropathic pain. At the time of the survey, human-labeled products were only available, but in 2021, pregabalin was approved by the EMA for alleviation of acute anxiety and fear associated with transportation and veterinary visits for cats (Lamminen et al., 2021). In addition, use of gabapentin has been reported in cats (Kruszka et al., 2021) and dogs (Stollar et al., 2022). In this survey, the use of pregabalin was only occasional. In addition to pain alleviation, gabapentin was sometimes used for anxiety and phobias, particularly in cats. In cats, gabapentin has been reported to reduce stress and aggression related to transport and handling (van Haaften et al., 2017; Pankratz et al., 2018). In dogs, it has recently been shown to alleviate storm phobia (Bleuer-Elsner et al., 2021), but it was not used for that indication in our survey.

As expected, opioids and tramadol were widely used for the alleviation of pain in both dogs and cats. However, butorphanol was also used in both species for various undesirable behaviors such as anxiety, phobias, and aggression. Actually, it has been recommended to treat suspected pain first since many forms of undesirable behaviors, such as fear and anxiety, defensive and aggressive behaviors, house-soiling problems, and attention-seeking, may also be suggestive of pain (Camps et al., 2019; Mills et al., 2020). The national legislation does not allow injectable opioids to be delivered by the owner, but tramadol tablets and human-labeled butorphanol can be prescribed for animal use.

The use of MAO inhibitors was minor in this study. Selegiline has been FDA-approved for the treatment of canine cognitive dysfunction syndrome (Campbell et al., 2001), but EMA has not approved it for veterinary use. No clinical studies could be found about its use in feline undesirable behaviors. In our survey, MAO inhibitors were used a few times for canine and feline dementia, and occasionally for other indications in dogs and cats.

Amantadine and buspirone were not reported to be used for the alleviation of canine or feline undesirable behaviors in this survey. Therefore, they are not discussed any further.

Medication for undesirable behaviors in cats and dogs should always be combined with behavior modification and environmental changes (Denenberg and Dubé, 2018). Behavioral therapy with the management of triggers has been shown to be highly effective in reducing, for example, separation-related problems even without medications (Podberscek et al., 1999). Therefore, it was a welcome finding that the majority of respondents reported having been given behavioral advice in addition to or instead of medication. Dog owners received more often behavioral advice than cat owners in addition to medication. This may be a result of the tradition in training dogs, although cat behavioral training is likewise possible (Halls, 2018).

The study sample may have been biased because it is likely that practitioners interested in small animal behavior were more motivated to fill in the questionnaire than those who seldom meet and treat such cases. Therefore, the sample may not have been representative of all practicing veterinarians in Finland. Moreover, benzodiazepines, MAO inhibitors, and tricyclic antidepressants were asked as classes to reduce the number of medications in the questionnaire, because there were many medicines for human use in these classes. This foiled further observing of individual medicines in these classes. Nevertheless, the study revealed the wide off-label use



of medications for canine and feline undesirable behaviors. Furthermore, many medications were used for such indications and/or species for which no research-based evidence for their efficacy could be found. The wide variety of medications used for some particular indications suggests that no single substance was perceived to yield a satisfactory treatment response in that indication in that species. This highlights the need for better-targeted medicines and/or more specific diagnosis to select the accurate treatment. More clinical research is therefore warranted on the efficacy of medications, behavioral training, and changes in living conditions for treating various canine and feline undesirable behaviors.

## Conclusions

A wide variety of medications are used to treat canine and feline undesirable behaviors. Off-label use of psychoactive medicines is common, and many medications are used without research-based evidence of their efficacy for the indication in the species. Dog owners were more often than cat owners given advice for behavioral training and management in addition to medication. Taken together, this study reveals the need for further clinical evidence of the efficacy of medications in the treatment of various canine and feline undesirable behaviors.

## Ethical Considerations

The study was an anonymous questionnaire study. Therefore, no animal experiment license nor other ethical approvals were required according to the national legislation.

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## Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.jveb.2024.04.005](https://doi.org/10.1016/j.jveb.2024.04.005).

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