

COMMON FELINE PROBLEM BEHAVIORS

Urine spraying

Debra F Horwitz



Communication and the function of urine spraying

Cats use a range of modalities (ie, body postures, facial expressions, tactile stimuli or touch, and grooming and scratching with claws) as means of communicating information, as discussed elsewhere in this feline behaviour special issue series. Urine spraying is a form of communication that utilizes olfactory and visual cues to transmit information. Communication in domestic species is often predicated on that of their wild counterpart. The most likely ancestor of the domestic cat is the African/Arabian wildcat, which is territorial and often solitary. The use of scent marks thus allows communication without face-to-face encounters. Scent marks can remain in the environment for some time, though are subject to the vagaries of the weather and also the behavior of any other individuals encountering the mark (ie, whether they spray over the existing scent mark).

Urine marks within the home are often found in socially significant places such as on owner possessions or laundry, or in prominent locations.



It is generally recognized that urine marking is a normal felid behavior. It is utilized by intact males and females to advertise availability for mating. Beyond that it is not clear how urine marking functions cat-to-cat other than that it involves a volatile substance, and intact male urine in particular is pungent and usually offensive to the human nose.

Felids deposit urine either by squatting or standing and both male and female cats can spray urine on vertical surfaces. Urine marks within the home are often found in socially significant places such as on owner possessions or laundry, or in prominent locations. Cats that mark with urine on vertical surfaces usually continue to use the litter box for elimination of both urine and stool. Although often considered to be a behavior of intact animals, neutered animals will urine spray and cats will often mark inside the house as a territorial response to the presence of outside cats.

Characteristics of urine spraying

Urine spraying in cats is categorized as either sexual (to attract mates) or reactionary (in response to social or environmental triggers). It usually occurs with a characteristic posture, where the cat will lift its tail, back up to an object, tread with the rear feet and expel urine backwards onto the object.

Practical relevance: Urine spraying (synonymous terms include urine marking or scent marking) is commonly described as urine deposited on vertical surfaces while the cat is in a standing position. With the increasing trend of keeping cats indoors in some countries and the potential resultant increase in frustration-related behaviors, urine spraying may occur in the home. Although also a normal feline behavior, it is usually not deemed acceptable when the cat targets household possessions. Urine spraying is a common behavioral complaint that practitioners receive from cat owners and has the potential to disrupt the human–cat bond. In fact, feline elimination issues are a frequent reason cited by owners when they relinquish their cats to shelters and rescue organizations.



Clinical challenges: While the location of the deposited urine should be diagnostic, this is not always the case. Urine marking can occur on horizontal surfaces, thus complicating the diagnosis. Urine spraying by intact males and females is used to signal availability for mating but the behaviour can also be exhibited by neutered animals. Multiple factors including medical problems can trigger the onset and maintenance of urine spraying, and correct identification of these is necessary for treatment to be most successful.

Evidence base: This review draws on information from multiple studies that have been published on the normal aspects of urine spraying in cats, the frequency as reported by owners, the relationship of urine spraying to intercat aggression and various treatment options including behavior modification, pheromone therapy and use of psychoactive medication.

Keywords: Urine spraying; vertical deposition; normal behavior; intercat aggression



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It is not totally clear what message is sent by the spraying cat and what is received by cats that encounter the scent. Cats will investigate the urine of other cats deposited on horizontal surfaces and the duration of sniffing increases when the urine is from an unfamiliar cat. Natoli's research found that vertical spray marks of unfamiliar tom cats were investigated for longer than those of familiar cats, and also longer than horizontal surface eliminations from unfamiliar toms.¹ Spray marks from estrous females initiate a flehman response in males and likely carry some information that is salient to the cat. However, the territorial function of urine spraying is unclear.

A study by Pryor et al on urine-spraying cats found that male cats and cats from multi-cat households were significantly over-represented in the study sample.² When owners were asked about potential causal factors, the most commonly cited ones were agonistic interactions with other cats inside or outside the home.²

Prevalence of urine spraying in owned cats

It is well accepted that intact male and female cats routinely urine spray. However, in the USA and many European countries cats are commonly neutered (see box below). The prevalence of urine spraying in household cats is variously determined based on owner reports to clinicians or to shelter/rescue personnel upon animal relinquishment, and in retrospective studies.

Bamberger and Houpt's retrospective study reviewed 736 cats presented to the Animal Behavior Clinic at Cornell University over a 10 year period (1991–2001).⁶ Examined records varied in how behaviors were classified but these investigators recorded 128 cats presented for marking behavior and 128 cats for spraying; it is unclear if these are different groups of cats or concomitant diagnoses for an individual cat. Male cats accounted for 75% of the cases.

Definition
Urine spraying or urine marking is the deposition of urine, usually on vertical surfaces outside of the litter box, for the purposes of communication among cats.

Undesirable indoor elimination, including urine spraying, is often the number 1 behavioral reason for relinquishment of cats to shelters.



Undesirable indoor elimination (38% in one study) is often the number 1 behavioral reason for relinquishment of cats to shelters, but often the type of objectionable elimination (eg, urination, defecation, urine spraying) is not specified.⁷ Casey et al's 2015 study looked at over 6000 cats relinquished or returned to rescue facilities in the UK over a 1 year period. Of the relinquishments overall, 7% (449 cats) were for behavioral reasons. The data for these 449 cats broke down as follows: 161 (36%) owners reported aggression between cats in the household; 77 (17%) reported house-soiling; 65 (14%) reported aggression towards people; 53 (12%) reported fearful behavior in one or more contexts; 45 (10%) reported problems associated with dogs; 44 (10%) reported one or more other behaviors; and four (1%) reported scratching. Of those cats that were adopted and subsequently returned, the main reason given was behavior (38%) – a far greater proportion than for relinquishments in general.⁸

Obtaining medical and behavioral information for urine spraying

Four major areas should be covered when taking a behavioral history for a cat that is urine spraying. First, medical contributions to changes in behavior must be ruled out, remembering that a learned component may exist and the behavior might continue after treatment. Secondly, a complete description of the behavior should be obtained, including what problem behavior is observed, where it occurs, time course, frequency of the behavior and previous treatments. Thirdly, whenever elimination behavior problems are present, gathering litter box information is essential (a home life and environment questionnaire, which includes questions about the litter box, can be found in the article in Part 1 on **behavioral awareness in the feline consultation**). Finally, if the household has additional animals, especially other cats, the social situation, as well as any environmental or stressful influences, must be explored.

Effects of neutering on the expression of objectionable behaviors

By removing hormonal influences, spaying and castration have long been used to diminish the expression of sexual behaviors. In companion cats these behaviors include roaming, fighting, mating and urine spraying. However, the results vary across individuals and perhaps with the timing of gonadectomy (eg, prepubertal or postpubertal) and age.

Hart and Cooper, in 1984, looked at prepubertally neutered male and female cats and determined that about 10% of male cats and 5% of female cats continued to urine spray into adulthood; furthermore, the timing of gonadectomy was not a factor in their tendency to fight or spray later in life.³ A later study in 2000 examined the outcome of gonadectomy performed at

an early age (<24 weeks) or the traditional age (≥24 weeks).⁴ This study concluded that concerns for an increased incidence of physical or behavioral problems in early-neutered cats were not noted based on the 3 year period after gonadectomy. An even more recent study came to the same conclusions based on outcome measures for kittens adopted from shelters and neutered at differing ages.⁵ Therefore, while neutering does change the frequency of urine spraying behavior in cats, it does not prevent the behavior in all cats.⁵

Neutering does not prevent urine spraying in all cats.

Investigating medical contributions

Initially in a behavioral consultation it is essential to rule out medical disease as either the sole cause of the behavioral change or contributing to the expression of the behavioral complaint. Recommended screening tests include a complete blood count (CBC), biochemistry profile, urinalysis and perhaps other tests and imaging studies as indicated by the history or physical examination.

As with any diagnostic work-up, obtaining pertinent and complete information is essential. Before beginning the behavioral history the clinician should determine if the cat has been gonadectomized. In male cats examination of the penis for penile barbs may often indicate circulating hormone levels; in female cats evidence of estrous behavior may be present. In either case, if the findings are positive, hormonal assays should be performed. Additionally, the practitioner should ask the owner why they believe that this is the cat responsible for depositing the urine marks.

Several studies have looked at the potential contribution of medical problems to the expression of urine spraying in cats.

It is likely that many urine-spraying cats have no urinary tract disease.



Frank et al assessed 34 urine-spraying cats with a combination of physical examination, CBC, biochemistry profile, urinalysis, urine culture, urine cortisol:creatinine ratios and abdominal radiographs. Thirteen patients (38%) had abnormalities or crystalluria. Seven of them had underlying medical conditions (renal calculi, renal failure, cystic calculi, bacterial urinary infection or cystitis associated with the presence of ammonium biurate crystalluria); the others had crystalluria only.⁹

Tynes et al's case-controlled study evaluated the role of urinary tract disease in gonadectomized urine-spraying cats.¹⁰ The study included 58 gonadectomized cats (47 males and 11 females) with urine-marking behavior (ie, marking on vertical surfaces) and 39 (26 males and 13 females) with no problem urination or urinary tract-associated conditions. Urine was collected by cystocentesis from all cats for urinalysis. Comparison of the data from cats with urine-marking behavior and control cats revealed no differences that could be associated with urine marking.¹⁰ It is likely that many urine-spraying cats have no urinary tract disease.

Case notes

Merlin, an 11-year-old neutered male Ragdoll/Manx crossbreed cat weighing 13 lb (5.9 kg), was presented to the veterinary behaviorist for ongoing (>1 year duration) urine marking within the home, weight loss and increased aggressive behavior towards people and the two other resident cats.

Medical history

- ❖ Early medical history noted past urinary blockages that had resolved.
- ❖ The owners reported increased aggressive and moody behaviors. Merlin was barbering his hair and displaying peruria outside of the litter box.
- ❖ The referring veterinarian performed blood work, urinalysis and electrocardiography and all results were within normal limits. Dental disease was also noted and dental cleaning was performed.
- ❖ Previous behavioral treatment included buspirone 2.5 mg q12h given over several months without appreciable improvement.¹²
- ❖ At an earlier veterinary examination early hyperthyroidism was suspected and Early HyperThyrin (a nutritional supplement by Natural Pet Rx sold in the USA to support thyroid health) was dispensed for daily administration.
- ❖ At follow-up at 1 month there were no changes in Merlin's behavior; the urine spraying continued and aggression had increased.

Behavioral history

- ❖ At the time of the behavioral consultation Merlin was still on buspirone (5 mg q24h), as well as a feline anxiety and stress nutritional supplement and Early HyperThyrin. No change had been noted and the weight loss was ongoing.

- ❖ At home Merlin was separated from the others due to his current aggressive behavior and urine spraying. Evidence of overgrooming with subsequent hair loss was noted on his forelegs and side of the body.
- ❖ Merlin continued to utilize a litter box to empty his bladder and bowel.
- ❖ Urine spraying was verified by the owners' observations and description.

Physical findings and examination room behavior

- ❖ Merlin was active and slightly agitated throughout the consultation, roaming and investigating the examination room. His physical condition was normal; although he had lost weight, he was not too thin.
- ❖ It was noted, however, that his facial features had changed and he looked 'jowly', like a mature intact male cat.
- ❖ During the course of the consultation, Merlin turned, lifted his tail and urine marked the cabinet. The urine odor was strong and had the distinct smell of an intact tom cat. The owner verified that this was the urine odor noted at home.

Behavioral diagnosis

Further testing was requested, including blood testosterone measurement (no spines were noted on penile examination) and adrenal ultrasound. Results revealed elevated blood testosterone and an adrenal tumor, which led to the behavioral diagnosis of urine spraying due to sources of endogenous testosterone. Surgery to remove the tumor was successful in decreasing urine spraying and aggression. However, in some especially trying social situations Merlin would still urine spray.

Cats with behavioral clinical signs of aggression, reduced interaction with the owner, weight loss or gain, poor grooming habits and house-soiling should be evaluated for a potential endocrine disorder.



Cats with endocrine disorders frequently manifest behavioral changes and clinical signs that can be confused with primary behavioral disorders. Hyperthyroidism, for example, is a common feline endocrine disorder that will cause dramatic physical and behavioral changes in cats, including hyperphagia, polydipsia, polyuria and loose stools.¹¹ Any cat showing behavioral signs such as aggression, reduced interaction with the owner, weight loss or gain, poor grooming habits and house-soiling (which may, in the author's experience, include urine marking) should be evaluated for a variety of feline endocrine disorders.

Disorders of the adrenal gland may result in altered levels of stress hormones or testosterone, both of which may affect behavior. Increases in testosterone may result in intact male behaviors (eg, urine marking, aggression, mounting) in already neutered animals, and laboratory assessment of blood testosterone levels and ultrasound studies will aid in the diagnosis of these disorders (see 'Case notes' on page 211).¹⁰

Obtaining a complete description of the behavior and situation

Clinicians should ask enough questions to clearly understand the situation (see box below). A diagram of where urine spray marks are located is also useful. Urine spraying located by windows and doors may indicate that outdoor cats or other disruptions are triggering the behavior. Often urine spraying is directed at new items brought into the home (eg, shopping bags, strollers or new furniture) that have caused scent disruption in the environment. Since urine spraying is a form of communication, it is often exhibited in prominent locations – a message is best noted in common areas.

Essential to formulating a treatment plan and assessing treatment efficacy is an initial determination of the frequency of urine spraying when a patient is first evaluated. This might be the number of urine marks per day, per week or per month. If the owner is unable to provide this information at the time of the consultation, it can be suggested that they utilize a black light device to identify and count urine marks to get some idea of the frequency and locations. (Note that this is not a definitive method because many other things fluoresce such as other bodily fluids and detergents.) A reduction in the number of urine-spraying marks noted in the home is useful to determine the efficacy of treatment. Assessing the frequency of the behavior is akin to assessing laboratory results; for example, for an elevated white blood count one hopes that treatment will make it decline. The same is true for the frequency of objectionable behaviors and intervention with behavioral therapies.

Gaining a full understanding of the urine-spraying situation

All terms utilized by pet owners should be defined by the practitioner and compared with owner beliefs. Owners might use the term 'spraying' for all urine deposited outside of the litter box, regardless of the cat's posture or urine location. Questions that are therefore helpful to ask include:

- ❖ What type of elimination is deposited outside of the litter box; urine, stool or both?
- ❖ What is the location of the deposited material?
Urine spray marks would be expected on vertical surfaces, about 8–10 in (20–25 cm) from the floor, and urine may run down onto the baseboards/skirting boards or the floor itself (Figure 1). Urine deposited horizontally only on personal possessions may also denote marking.
- ❖ Is this a new or ongoing problem? Establishing the duration and progression of the problem behavior is essential. Marder and Engel looked at treatment outcomes for house-soiling cats and found that longer duration problems were rated by owners as less improved or worse.¹³



Figure 1 Cats that urine spray are usually standing with their tail upright, and perhaps 'treading' their feet. Courtesy of Dr Margie Scherk

Previous treatment strategies employed (eg, behavioral, medication, pheromones) must also be discussed, determining how long each was applied and any perceived results. In some cases previous treatments may have been worthwhile but perhaps not properly applied or not used long enough, or resulted in a decline in urine spraying but not complete cessation.

Gathering litter box information

Since most urine-spraying cats continue to use a litter box to empty the bladder and to defecate, litter box information must be collected.

Typically, this should include:

- ❖ Number of litter boxes available within the home
- ❖ Sizes of litter boxes provided
- ❖ Location of the boxes
- ❖ Litter material used
- ❖ Frequency of cleaning – both scooping out waste and total emptying, washing and refilling of the litter boxes.

Discussing the home environment

Finally, a discussion of the home environment should be included, covering cat-to-cat interactions, any changes within the human family, new work hours, and so on (all of which have been correlated with urine spraying^{2,14}). Clinicians should ask about feeding routines and the number of available feeding stations. Daily interactions between the pet in question and the owner/family, as well as other animals within the home, can be explored.

Any changes in the home or household routine – however minor – can be important. Often owners are unaware that a change they instigated and have planned for may be upsetting to their pets when it is put into place. A new job, additional time away from home for various reasons, or the addition of a new family member, are all types of stressors that are associated with changes in behavior.¹⁵ A study by Ramos et al suggests that cats living with other cats are not more stressed, as evidenced by fecal glucocorticoid levels, but that stress may actually be related to other factors including resource availability and the relationship with the owners.¹⁶

Veterinarians may not see all the pets within a household, and so it is important to establish how many other pets there are, especially additional cats. Further information on the social relationship between cats in the household, including any overt signs of aggression (hissing, growling, chasing) and covert signs of aggression (blocking, staring, supplanting from spaces) should be gathered. The management of conflict between household cats is discussed in an accompanying article in this issue on [aggression in multi-cat households](#).

Information about the household routine and any changes, however minor, can be important.



Importantly, clinicians should be aware that other cats within the home may also be urine spraying, making it essential that all participants are identified. In some cases agonistic interactions may result in feline house-soiling by other cats and this is important to identify and treat.

Establishing a diagnosis of urine spraying

A diagnosis of urine spraying should be based on the location of the deposited urine and the posture of the cat. Although, as discussed, some cats do mark on horizontal surfaces, this is not the most common location for urine eliminated by a marking cat. In some cases, use of a black light can help owners to visualize urine marks, though this has limitations as already mentioned. A diagnosis of urine spraying must also include the ruling out or treatment of any medical contributions. Moreover, vital to successful treatment is the identification of the suspected triggers (see box below). Once these are known, treatment should include behavioral modification (see article in Part 2 on [environmental and behavioural modification](#)) to change the underlying emotional state resulting from these triggers and/or removing them when possible.

Common urine-spraying triggers

- ❖ Sexually intact cat (male or female)
- ❖ Agonistic interactions with non-resident cats outside the home (Figure 2)
- ❖ Environmental issues or social changes that may cause frustration, stress or distress:^{2,13}
 - Relocation to a new home
 - Change in the owner's daily schedule
 - Change in the owner's interaction with the cat
 - Suboptimal litter box management
- ❖ Agonistic social relationships between cats within the home

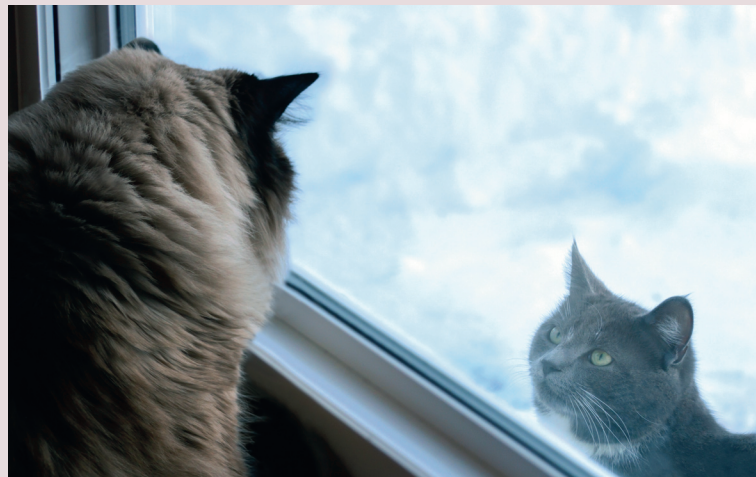


Figure 2 A potential trigger for urine spraying may be the presence of non-resident cats outside the home. Image ©iStock/Greenseas

Treatment of urine spraying

The treatment of urine-spraying behavior includes addressing the underlying causes that have been identified in the diagnosis: neutering intact cats; increasing litter box attractiveness; attempting to resolve the social issues between resident cats; addressing environmental triggers, including controlling the influence of outside/intruder cats; keeping a constant scent profile in the home; creating an enriched environment; scheduling interactive time with the owner that is predictable, positive and consistent; and avoiding change when possible. When there are multiple cats in the home, urine spraying may occur to delineate territory, or due to a lack of adequate resources or space or the stress of too many cats, and these issues must be addressed to aid in resolution. Additional interventions include the use of pheromones, nutraceuticals and psychoactive medications.

Increasing litter box attractiveness and cleaning urine marks

The litter box should be well located and very clean. Pryor et al examined the effects of environmental management for urine-marking cats and found that cleaning the urine marks daily, scooping waste from the litter box daily and changing the litter and cleaning the litter box weekly resulted in up to a 50% decrease in urine-marking behavior.² Therefore, waste material should be scooped out once or twice a day, and owners must empty and wash the litter box and replace with entirely fresh litter every 3–4 days for clay litter material and every 1–2 weeks for clumping litter. The depth should be adequate; 3–4 in (~8–10 cm) seems preferred. Research has shown that some cats prefer the clumping materials to clay litter, so switching to a clumping-type product may be beneficial.¹⁴

Litter boxes must be easily accessible, and positioned in quiet locations and where the cats spend their time. Where and how to allocate litter boxes should be decided based on information about the household routine, the number of other cats within the home and the social relationship between individuals. In multi-cat households there should be an adequate number of boxes (one box per cat plus one additional); these need to be in different locations, and not just placed side by side.

Since urine marking is a normal feline behavior, some cats will respond to the creation of an acceptable spraying station. Owners can create an 'L'-shaped litter arrangement with two litter boxes – one positioned horizontally with litter inside, placed up against another that is empty and orientated vertically (Figure 3a); alternatively, one litter box could be leaned against a wall (Figure 3b). Some cats will use this set-up and limit their urine spraying to this location.

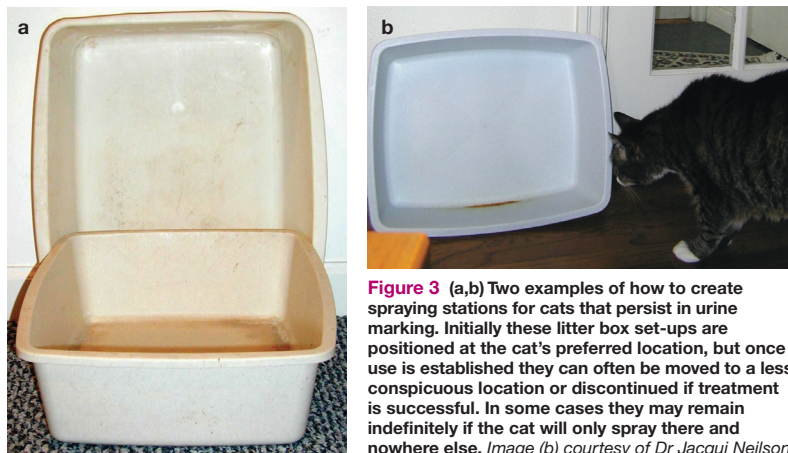


Figure 3 (a,b) Two examples of how to create spraying stations for cats that persist in urine marking. Initially these litter box set-ups are positioned at the cat's preferred location, but once use is established they can often be moved to a less conspicuous location or discontinued if treatment is successful. In some cases they may remain indefinitely if the cat will only spray there and nowhere else. Image (b) courtesy of Dr Jacqui Neilson

As well as cleaning of urine spots (see accompanying article on **unacceptable indoor elimination**), attempts can be made to make the sprayed areas undesirable for future elimination. This might include placing potpourri at the spot and/or food bowls to attempt to change the function of the location either by introducing an unattractive (to cats) smell or encouraging food consumption; alternatively, a urine station can be placed at the location (Figure 3). Although, motion sensors that make loud noises to keep the cat away from the area can be utilized, these can cause fear and anxiety in some cats and are not particularly helpful or kind. Blocking off access to areas where urine spraying occurs (Figure 4) can be a useful environmental modification, but may not be a long-term solution if other inciting stimuli (social conflict with other cats, lack of access to boxes or hiding areas) are not addressed and resolved.

An effort should be made to minimize scent disruption within the home. This might include leaving strollers and prams outside instead of bringing them indoors, placing gym bags with soiled clothing out of reach, and delaying purchases of new furniture, if possible, until urine spraying is controlled.

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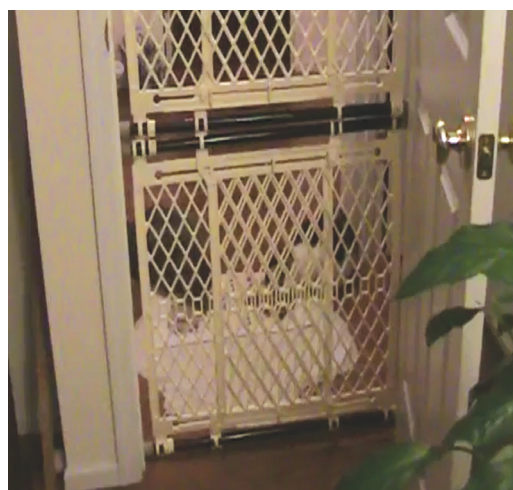


Figure 4 Double baby gates can be used to keep cats in one place and stop them from spraying in a location that will damage household possessions; this method may not be useful long term, however, if other inciting stimuli are not addressed

Dealing with social issues between cats

Resident cats

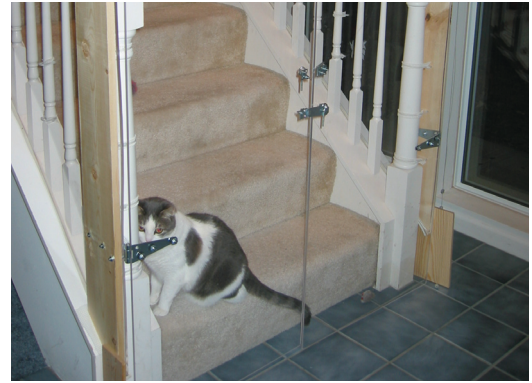
Ensuring adequate numbers of important resources such as food bowls, resting places and litter boxes are provided throughout the environment may help to diminish social tension and perhaps spraying behavior (see article in Part 2 on **environmental and behavioural modification**). Ideally the places with these items should have more than one entry/exit point to keep a cat from being trapped by an aggressor. In situations where the number of cats is causing conflict, it may be difficult to eliminate or decrease spraying behavior without addressing how the cats interact (see accompanying article on **aggression in multi-cat households**).

In some households it may be necessary for the space to be time shared, allowing cats that do not get along to be separated for some part of the day. Providing separate locations for each cat may allow them to create a sense of ownership without spraying, using facial marking instead. The separate spaces should each have a food bowl, water bowl, litter box and adequate resting and hiding locations. Social interactions with owners must also be consistent and positive. For some cats the provision of spraying stations (Figure 3) may allow the cat to spray in an easily cleaned area. In some cases the household may be divided to limit the interactions between groups of cats (Figure 5).

Outside/intruder cats

Attempts should be made to limit the visibility of outdoor cats to the resident cat(s)¹⁷ and to discourage intrusion by those cats if possible. Blocking visual access from windows and doors, or closing the cat in a room where it

Figure 5 After prolonged therapy the owners of this cat divided the home into two separate zones and the resident cats lived happily without fighting or urine spraying



cannot see outside cats, are useful measures. Motion sensors or fences and the removal of bird feeders may keep some outdoor cats out of the yard and out of sight.

Introducing positive and predictable social interactions with owners and appropriate environmental changes

An effort should be made by the owner to have predictable, consistent and positive interactions with the cat, including grooming and playtime. Reward-based training may also help to keep cats mentally active and relaxed. Additionally, positive associations can be made during these sessions with new objects brought into the home to help ease the adjustment for the more timid cat. The provision of climbing towers (Figure 6) or shelves can help cats arrange themselves vertically within the space they have. Punishment should always be avoided as it can increase anxiety and create fear of the owner. The cat's access to previously sprayed areas should be restricted by closing doors or blocking doorways with baby gates or other means (Figure 4).

Ensuring adequate numbers of food bowls, resting places and litter boxes throughout the environment may help to diminish social tension and so perhaps spraying behavior.

Follow-up for urine spraying

A follow-up progress report should be obtained 7–10 days after introducing any environmental or behavioral modification or pheromone therapy. Attempts should be made to count the number of urine marks and determine whether there has been a decrease in the frequency of spraying since the institution of treatment. For most behaviors it will take 4–8 weeks before any change is noted, so initially a decrease in the number of episodes of urine spraying should be considered a successful response. Total elimination of urine spraying may take time. For cats that have been spraying for only a short duration (<1 month) change may occur within 4–6 weeks. Cases with longer histories may take several months. In many instances there may be a decrease in urine spraying without complete cessation. Return of any inciting stimuli or triggers may cause urine marking to recur.



Figure 6 Climbing towers allow cats to arrange themselves vertically, helping to provide a safe location away from, for example, another cat. Courtesy of Cathryn Jordan

Pheromone therapy

A pheromone spray or diffuser (Feliway Classic; Ceva) can also be very useful in the treatment of urine marking. Feliway is a synthetic analogue of the F3 feline facial pheromone and can help to decrease or stop spraying behavior. In a study by Mills and Mills, cats exposed to Feliway in the diffuser form showed a decrease in urine marking when compared with cats treated with placebo.¹⁸ Feliway is often effective in decreasing urine spraying in response to reactional stimuli such as changes in the cat's environment (moving, new pets, stress, etc). Pheromone therapy has also been used to calm cats in new environments.¹⁹

For cats that are showing agonistic interactions, whether covert or overt, a synthetic analogue of feline appeasing pheromone – Feliway MultiCat (USA) or Feliway Friends (Europe) (Ceva) – may diminish reactivity and promote calmer behaviors.²⁰

See article in Part 2 on [pheromone therapy](#) for further information.

Pharmacological treatments

Drug therapy can be a helpful adjunct to behavioral treatment by decreasing the emotional arousal that may motivate urine spraying (see 'Case notes' below). When considering drug therapy, a complete behavioral and medical history should be obtained prior to choosing a medication. Drugs used

Drug therapy can be a helpful adjunct to behavioral treatment by decreasing the emotional arousal that may motivate urine spraying.



for problem behaviors are not approved for use in cats, except for clomipramine, which is licensed in Australia for cats that are urine spraying;²¹ therefore, in the majority of cases treatment involves extra-label drug usage. Complete serum biochemistry and possibly cardiac work-ups are indicated prior to use. Owners need to be informed of potential side effects and extra-label use, and consent and release forms should be obtained. Frequent client contact to assess efficacy and any side effects of drug therapy is necessary. Owners should be encouraged to be at home for the first few doses to observe for any effect or side effects.

Drug therapy should be instituted only when a behavioral diagnosis has been made. Drug therapy alone is rarely curative and is best used in conjunction with behavior therapy. Cats with behaviors caused by stress, territorial stimuli or anxiety are more likely to show some response to medication. Elimination outside of the litter box due to litter or location aversions or litter cleanliness problems is rarely improved by drug therapy alone.

Currently the commonly used drugs are selective serotonin reuptake inhibitors and tricyclic antidepressants (see article in Part 2 on [psychoactive medications](#)). Other agents have been used in the past, including buspirone,¹² benzodiazepines²² and progestin,²² and are not discussed in this article.

Case notes

Petey, a 2-year-old neutered male cat, presented with a history of intermittent house-soiling outside of the litter box, which also included occasions of urine spraying. Petey lived in a home with two adults and one other cat.

Medical history

Aside from occasional urinary tract infections in the past, Petey was in good health and his physical examination and urinalysis were within normal limits.

Behavioral history

Over the past few months, while Petey's owners were remodeling the home, he had begun to urine spray. During the ongoing remodeling the cats were confined to the basement during the day and only had one litter box. The history also revealed an increase in agonistic interactions between Petey and the other cat. Petey had an anxious temperament, frequently following his owners about and vocalizing loudly for things he wanted, such as outdoor access.

Behavioral diagnosis

The behavioral diagnosis was urine spraying due to environmental disruption and an associated increase in anxiety.

Treatment plan

The owners were advised to:

- ✦ Create a quieter place for Petey during the remodeling.
- ✦ Place a Feliway diffuser in the safe location.
- ✦ Provide additional litter boxes, scoop out waste material daily and change the litter and wash the box weekly.

Follow-up and drug therapy

During the first week following the appointment Petey urine sprayed once. Two weeks later he was calm, and within 1 month all urine spraying had ceased.

Two months later, the owners began another house remodeling project. The cats went to live elsewhere but soon after they returned home Petey began to urine spray once more. Urinalysis revealed hematuria and infection; treatment with antibiotics resolved the urine spraying.

Four months later Petey began urine spraying again, but this time no infection was noted. The referring veterinarian started him on amitriptyline therapy, but this produced no results. Petey was therefore referred back to the veterinary behaviorist who instituted fluoxetine (1 mg/kg q24h); the urine spraying ceased within 6 weeks of treatment. Petey was subsequently put on long-term fluoxetine for 32 weeks, with a good outcome and no subsequent return to urine spraying.

Fluoxetine

In a double-blind placebo-controlled clinical trial, Pryor et al tested the effectiveness of fluoxetine hydrochloride for the treatment of urine marking.²³ In the drug treatment phase each cat received either drug (1.0 mg/kg q24h) or placebo for 8 weeks and owners recorded the urine marks observed. Each household followed an environmental plan, used the same cleaner to remove urine marks, had one more litter box than the number of cats in the home, and scooped the box daily and changed the litter and washed the box weekly. Cats on the medication showed a significant decrease in urine marking when compared with placebo by weeks 7 and 8. A correlation was found between marking at baseline and return to marking after the drug was withdrawn (ie, cats that marked more frequently were more likely to resume marking).

Fluoxetine can take 2–4 weeks to produce an effect on behavior. The most common side effects are gastrointestinal, such as anorexia, nausea and diarrhea, but may also include sedation, irritability and anxiety.²⁴

Clomipramine

Clomipramine has also been shown to be efficacious in the control of urine spraying in cats. The drug is a tricyclic antidepressant with both serotonin reuptake blocking and some norepinephrine reuptake blocking effect. A change in behavior may not be noted for 2–4 weeks after initiation of therapy. Common side effects include urinary retention, tachycardia, depression and inappetence.²⁴

In a study by Landsberg and Wilson, 25 urine-spraying cats were treated with clomipramine at 0.54 mg/kg PO q24h without any behavior modification applied.²⁵

Transdermal administration

Medicating cats orally can be a challenge. Thus, while the transdermal route might be considered an attractive alternative, recent studies have unfortunately not been able to demonstrate good absorption and bioavailability of psychotropic medication when administered transdermally. Ciribassi et al showed that although fluoxetine was absorbed through the skin in cats, the relative bioavailability was only 10% of that for the oral route of administration.²⁸ Eichstadt et al compared oral administration of fluoxetine with transdermal administration and found that, while transdermal administration was well tolerated, blood concentrations did not vary much beyond baseline levels throughout the study and were low when compared with the oral route.²⁹ Mealey et al looked at the systemic absorption of amitriptyline and buspirone after oral and transdermal administration to healthy cats and found that systemic absorption of both drugs was likewise poor when administered transdermally compared with the oral route of administration.³⁰ Appropriate dosages for transdermal administration of these medications have not yet been established.

A statistically significant reduction in urine spraying was recorded, with 20/25 cats showing a $\geq 75\%$ reduction in spraying within 4 weeks.²⁵ Overall the side effects noted were mild and included sedation, and decreased appetite and urination. Another randomized controlled multicenter trial found that, when compared with a placebo, clomipramine significantly reduced the frequency of urine spraying in cats.²⁶ In this study behavioral and environmental modification was implemented for all cats

in addition to medication. The recommended initial dose was 0.25–0.5 mg/kg PO q24h.²⁶

Fluoxetine vs clomipramine

An additional study compared the use of fluoxetine and clomipramine in urine-spraying cats. As well as examining for differences between the two drugs in reducing urine-spraying behavior, the investigators also looked at: whether increasing the length of treatment (> 8 weeks) reduced the occurrence of urine spraying; if there was recurrence of urine spraying after abrupt withdrawal of the medication; and whether cats successfully treated with either medication that resumed marking after drug withdrawal could be treated successfully again with the same drug regimen.²⁷ Although the study was small, the data revealed that the efficacy of fluoxetine and clomipramine was similar. Fluoxetine showed increased efficacy in reducing urine marking when administered for longer than 8 weeks; however, some cats needed to be treated for 32 weeks to reach a $\geq 90\%$ reduction in urine marking. When fluoxetine was abruptly withdrawn, most cats reverted to urine-marking behaviors; however, those that responded to the first treatment regimen responded again to reinstatement of the medication.²⁷

How long to continue medicating?

Owners should be contacted at least every 2 weeks when first beginning medication for their cat's urine spraying. If the marking behavior responds to medication the drug should be continued for 8–12 weeks and at least 1 month beyond resolution. If the behavior has not returned, an attempt can be made to wean the cat off medication. Various strategies are utilized when weaning patients off medication; some decrease the total dosage by 25% a week while watching for a return of urine marking, while others decrease the total dosage by 25% a month. If the cat begins to urine spray shortly after dosage reduction then remaining at that

reduced dosage for an additional 2 weeks may allow the patient to stabilize in some cases. If urine spraying ceases, an attempt can be made to decrease the dosage further. If urine marking is ongoing, the dosage can be increased to the previous effective level.

Some cats live in stressful environments and attempts to wean them off medication result in the resumption of urine spraying. For these patients, the goal is to find the lowest effective dose. If a cat must remain on medication for long periods of time, blood chemistries every 6–12 months depending on the patient are prudent to check for liver or kidney value changes.

Prognosis

Marking behaviors have a variable response to treatment. Factors such as outside/intruder cats and the ability to control them, household social conflicts with other cats and ongoing household changes may all affect the potential for resolution of the spraying behavior.¹⁸ Ogata and Takeuchi found that while urine marking decreased with pheromone therapy, urine marking was sustained at a higher level in households with intercat aggression.³¹ Mills and White found that while urine marking decreased with pheromone therapy, it often was not eradicated.³² However, the reduction in spraying behavior was acceptable to the clients as an outcome. Marking behavior may persist or recur after medication is stopped. As discussed above, long-term usage of medication may be necessary to inhibit urine marking.²⁷

In some cases, despite intensive efforts at both pharmacological and behavioral therapy, urine spraying may remain at levels unacceptable to the owners. When this occurs, most often in a multi-cat home, rehoming is an option that may be suitable and improve pet welfare. In a calmer, less stressful environment urine spraying may diminish or even stop, allowing the cat to remain in a new loving home.

Acknowledgements

The title image of the spraying cat on page 209 is provided courtesy of Hazel Carney.

Conflict of interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

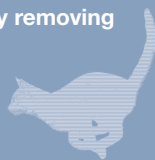
The author received no financial support for the research, authorship, and/or publication of this article.

SERIES OUTLINE
This article forms part of a series of evidence-based reviews on feline behavior, independently written by key opinion leaders, spanning three Special Issues of *JFMS*. Parts 1 and 2 were published in May and November 2018, respectively. An outline of the full series is included as supplementary material alongside the article at: cpsj.fjms.com



KEY POINTS

- ❖ Urine spraying is a common and normal but objectionable feline behavior.
- ❖ Diagnosis is based on the location of the urine (usually vertical) and certain known triggers (estrous females, intercat aggression, outside/intruder cats or social/environmental changes).
- ❖ Treatment focuses on decreasing the need to mark by removing the triggers, keeping litter boxes clean and plentiful, maintaining a consistent scent profile within the home and using pheromones and medication where needed.



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