Causes of urine marking in cats and effects of environmental management on frequency of marking

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Objective—To evaluate effects of environmental management alone on marking frequency in cats with urine marking and to obtain demographic data on cats with urine marking and data on owner-perceived factors that contributed to urine marking behavior.

Design—Single-intervention study.

Animals—40 neutered male and 7 spayed female cats.

Procedure—During a 2-week baseline phase, owners maintained a daily record of the number of urine marks. This phase was followed by a 2-week environmental management phase during which owners cleaned recently deposited urine marks daily, scooped waste from the litter box daily, and changed the litter and cleaned the litter box weekly while continuing to record urine marks.

Results—Male cats and cats from multicat households were significantly overrepresented, compared with the general pet cat population in California. The most commonly mentioned causative factors for urine marking were agonistic interactions with other cats outside or inside the home. Environmental management procedures resulted in an overall reduction in urine marking frequency. Among cats that marked ≥6 times during the baseline phase, females were significantly more likely to respond to treatment (≥50% reduction in marking frequency) than were males.

Conclusions and Clinical Relevance—Results suggest that male cats and cats from multicat households are more likely to exhibit urine marking behavior than females and cats from single-cat households. Results also suggest that attention to environmental and litter box hygiene can reduce marking frequency in cats, regardless of sex or household status of the cats, and may come close to resolving the marking problem in some cats. (J Am Vet Med Assoc 2001; 219:1709–1713)

Although cats are known for their fastidious elimination behavior, problem urination is one of the most common feline behavioral problems for which veterinary consultation is sought.14 Excluding physiologic problems involving the urinary tract, problem urination can be divided into 2 subgroups: inappropriate urination and urine marking or spraying. Inappropriate urination typically reflects disruption of normal litter box or outdoor toilet behavior such that cats change their toilet areas to inappropriate parts of the house.3 In contrast, urine marking is a normal behavior, at least for sexually intact male cats, that presumably relates to territoriality and may be related to repelling other males or gaining access to breeding females.7 When a cat urine marks, it typically maintains a standing posture with the hind limbs straight and the tail up and quivering; the cat alternately steps with the hind limbs and sprays urine on a vertical surface. During urine marking, urine may also be directed toward horizontal surfaces, and objects may be marked while the cat adopts a squatting posture. Commonly mentioned target objects are walls, appliances, and the owner’s bed or clothing.3 A commonly cited difference between inappropriate urination and urine marking is that with inappropriate urination, the litter box is typically not used for urination and, possibly, not for defecation, whereas with urine marking, the litter box is typically still used for urination and defecation.3 Urine marking is under hormonal control and is prevented in about 90% of male and 95% of female cats by gonadectomy.7

Both behavioral (environmental management) and pharmacologic approaches to the treatment of urine marking in cats have been emphasized in the literature.3,4,5 Open-label trials, in which no standard environmental management was employed, revealed that the behavior was eliminated or the frequency of urine marking was markedly reduced in 53 to 73% of cats treated with diazepam10,11 or buspirone.12 A recent placebo-controlled double-blind study13 combining standard procedures for cleaning urine-soiled areas and the litter box with administration of a selective serotonin reuptake inhibitor (fluoxetine hydrochloride) resulted in ≥90% reduction in urine marking in treated cats, compared with control cats. However, because of differences in drugs and trial designs, the degree to which environmental management (eg, reduction of ambient urine odors) alone contributes to the reduction of urine marking is unknown.

Information on the effects of environmental management alone on objectionable urine marking would help in formulating an overall approach to treatment of affected cats. The purposes of the study reported here were to evaluate the effects of environmental management on marking frequency in cats with urine marking and to determine whether environmental management had different effects in males versus females. The study
was also designed to collect demographic data on cats with urine marking and data on owner-perceived factors that contributed to the initiation and continuation of urine marking behavior.

**Materials and Methods**

**Recruitment of subjects**—The study was carried out at 2 clinical centers: the Veterinary Medical Teaching Hospital of the University of California School of Veterinary Medicine in Davis and the University of California Veterinary Medical Center-San Diego. Advertisements (4 × 4 in) announcing the study and soliciting participants were placed in the Sunday and either the Tuesday or Wednesday editions of regional newspapers. At the same time, letters announcing the study were sent to veterinarians with the same zip codes as the regional newspapers’ areas of delivery. The newspaper advertisements and the letters to veterinarians listed the following enrollment criteria: only 1 urine marking cat/household; ≥ 4 urine marks on indoor vertical surfaces/wk; ≤ 4 cats/household; the cat must have been neutered or spayed; and the cat must not have been receiving any medication for the problem behavior.

Calls from cat owners generated by the advertisements and mailings to veterinarians were logged into a telephone message system, and screeners contacted the cat owners and conducted a screening interview. For owners whose cats appeared to meet the enrollment criteria, an appointment was made with a veterinary behaviorist at 1 of the 2 clinical centers. There was no attempt in the recruitment advertisements or letters to veterinarians or during the screening interview to influence nomination of cats of a particular sex or of cats from single-cat or multicat households. Seventy-four enrollment appointments were completed with owners of cats that appeared to meet enrollment criteria during the screening interview.

**Study design**—During the enrollment appointment, an extensive interview was conducted seeking information on owner-estimated urine marking frequency and location of urine marks. Owners were also asked to identify what they perceived to be the causative factors for the initiation and continuation of urine marking. When appropriate, owner-identified causes were assigned to 1 of 5 categories: interaction with cats outside the home, interaction with other cats in the home, limiting the problem cat’s access to the outdoors, relocation to a new home, and a change in the owner’s daily schedule. However, owners were also given an opportunity to designate other causative factors. Only causative factors listed by ≥ 3 cat owners were included in the tabulation. If an owner listed > 2 causes, only the 2 most prominent causes were included. If the cat was from a multicat household, owners were also asked how they determined which cat was responsible for the urine marking. Most owners stated that they only saw the nominated cat marking or that only the nominated cat had access to the marked area. A judgment was made as to the reliability of the owner’s report, and the cat was included in the study only if the behaviorist believed that the owner’s judgment was reasonably accurate.

Owners were required to sign a consent form outlining their responsibilities during the study. A physical examination was performed, and a blood sample was collected and submitted for a CBC and serum biochemical analyses. Urine was obtained by means of cystocentesis (guided by means of ultrasonography, if necessary) and submitted for urinalysis. Following the enrollment appointment and review of hematology and urinalysis results, 23 cats were excluded because of abnormal physical examination, hematology, or urinalysis findings or because of a failure to meet behavioral criteria important to the conduct of the study. Owners of cats excluded from the study were given behavioral or medical advice for resolving the problem urination on a case-by-case basis.

The study included a 2-week baseline phase and a 2-week environmental management phase. During both phases, owners of cats recorded, on a daily basis, the number and location of urine marks. Only marks on vertical surfaces were used in data analyses, as they are a better indicator of urine marking than are marks on horizontal surfaces, which may be attributable to inappropriate elimination. During the 2-week baseline phase, owners were instructed not to change the cats’ environment or their manner of cleaning the litter box or changing urine deposits and to not physically punish the cats for urine marking.

During the 2-week environmental management phase, owners were provided with verbal and written instructions on instituting standardized environmental management procedures involving cleaning of urine marks and litter box hygiene. Owners were instructed to clean, on the first day of the environmental management phase, all detectable urine marks on vertical and horizontal surfaces, using an enzymatic cleaner that was provided to them. Additionally, owners were instructed to clean all solids and liquids from the litter box once daily and to completely change the litter material and wash the litter box once a week. For households with > 1 cat, owners were instructed to provide sufficient litter boxes so that the number of boxes equaled the number of cats plus 1. These were the only environmental and behavioral management procedures to be implemented. No change in the configuration of the litter boxes or type of litter was specified.

Owners were given forms on which they were required to enter the number of urine marks each day throughout the 4 weeks of the study. Owners were contacted on day 3 or 4 of the baseline phase to review the procedures and answer questions. Information about urine marking frequency and location was collected from the owners during weekly telephone calls and recorded on similar forms in the investigator’s office. Owners were instructed to mail their forms to the investigators at the end of the study, and an audit was performed to ensure that values obtained during telephone conversations were identical to those on the forms returned by mail. Any discrepancies were resolved by a telephone call.

**Data analysis**—Data collected during the enrollment interview were used to compare sex and household status (multicat vs single-cat household) of enrolled cats with sex and household status of the California cat population,10 to determine owner-perceived factors associated with the initiation and continuation of urine marking. To determine which cat owners typically identified urine marks and determined which cat in a multicat household was marking, and to identify common urine marking targets.

Data collected during the baseline phase of the study (weeks 1 and 2) provided a comparison between the frequency of urine marking estimated by the owner during the enrollment interview and the actual number of daily marks. Data collected during the environmental management phase of the study (weeks 3 and 4) were compared with baseline data to provide information on the overall effect of environmental management on the frequency of urine marking for all cats, as well as for a subgroup of cats that marked ≥ 6 times during the 2 weeks of the baseline phase. Data for week 4 were compared with data for week 3 to determine whether there was a lead-in time that might be associated with any decrease in urine marking behavior brought about by the environmental management. A cat was considered to have responded if the recorded urine marking frequency during the environmental management phase was ≤ 50% of the frequency during the baseline phase.

**Statistical procedures**—A z-test of proportion was used
to determine whether the distribution between sex and household status among cats meeting enrollment criteria differed from that of California households. Based on previous findings,1 we predicted that among cats meeting the enrollment criteria (spraying ≥ 4 times/wk), males and cats from multicat households would be overrepresented; these tests for significance were therefore 1-sided.

Paired t-tests with log transformations to achieve normality of data were used to compare the number of urine marks during week 1 with week 2 and during week 3 with week 4. After examining the suitability of combining data from weeks 1 and 2 (baseline phase) and combining data from weeks 3 and 4 (environmental management phase), a paired t-test with log transformation was used to test the hypothesis that environmental management would reduce urine marking frequency. Data were also examined to test the hypothesis that 1 sex might respond more to environmental management than the other sex. To carry out this latter analysis, a comparison was made between the males and females marking ≥ 6 times in the 2 weeks of the baseline phase with regard to those categorized as responding to environmental management (≥ 50% reduction in urine marking frequency). The remaining cats (n = 7) were examined with the log transformation to achieve normality of data distribution was used for comparison. Finally, a similar comparison of responders between sexes was made for cats from only multicat households, using a Fisher exact test. With the exception of the demographic comparisons between cats meeting enrollment criteria, all tests were 2-sided. For all analyses, values of P < 0.05 were considered significant. Statistical procedures were performed by use of a computer program.5

Results

Study participants—Screening interviews were conducted with owners of 418 cats, and enrollment appointments were made for 74. Of these 74 cats, 37 (77%) were male, and 17 (23%) were female. This was similar to the sex distribution of the 320 cats for which information on sex was obtained during the screening interview (the remaining 98 cats were screened out before information on sex was obtained). Of these 320 cats, 229 (72%) were male, and 91 (28%) were female.

Of the 74 cats examined during an enrollment appointment, 23 were excluded because hematologic or serum biochemical abnormalities were identified (n = 7), there was an insufficient number of urine marks or duration of marking (4), indications of owner non-compliance were identified (4), there were too many cats in the household (3), more than 1 cat in the household was marking (3), results of a urinalysis were abnormal (2), an abnormality was identified during physical examination (1), the cat was too old (1), or the cat had a history of recurrent cystitis (1). Some cats were excluded for more than 1 reason. An additional 3 cats were excluded because they did not mark during the 2-week baseline phase. One additional cat was excluded because the owner did not comply with instructions. The remaining 40 male and 7 female cats completed the baseline and environmental management phases of the study.

Causative factors for urine marking and detection of urine marks—The 3 most common causes of urine marking listed by owners of the 47 cats that completed the study (owners of several cats indicated > 1 factor) were agonistic interactions with cats outside the home (23 cats; 49%), agonistic interactions with other cats in the home (13 cats; 28%), and limiting the cat’s access to the outdoors (12 cats; 26%). Other factors that were cited included relocation to a new home (4 cats; 9%), introduction of a new inanimate object to the home (3 cats; 6%), a change in the owner’s daily schedule (3 cats; 6%), and interaction with the owner (3 cats; 6%). Owners of 10 (21%) cats did not know of a causative factor.

Owners listed the following methods used to detect fresh urine marks: sight (92%), odor (72%), observed cat marking at least once (21%), felt marks through contact (15%), and observed the problem cat or another cat investigating the marked area at least once (6%). Owners commonly used > 1 method to detect urine marks.

Owners listed the following targets for urine marking: furniture (91%), walls or windows near the point of interaction with cats outside the home (87%), other walls (72%), appliances (47%), novel items (23%), and pet-associated items such as the litter box or toys (13%).

Of the 47 cats, 42 (89%) were from multicat households. The most common method by which owners detected which cat in a multicat household was marking was observing the problem cat marking at least once (69%). In some instances, the problem cat was separated from nonproblem cats at least once when marking occurred (5%). Other methods mentioned included finding the problem cat in the marked area, noticing that other cats stayed away from the marked area, and noticing that the problem cat would hide after marking. In some instances, the problem cat had marked before other cats were adopted into the household. Some owners provided > 1 method by which they identified the marking cat and determined that this was the only cat in the home that was marking.

Sex and household status of enrolled cats—Male cats were significantly (P < 0.001; 1-sided z-test of proportions) overrepresented in the study (89% male), compared with the general population of pet cats in California (49% male). Similarly, cats from multicat households were significantly (P = 0.03; 1-sided z-test of proportions) overrepresented (89% resided in multicat households), compared with pet cats in the general population in California (78% resided in multicat households).

Frequency of urine marking—Frequency of urine marking estimated by cat owners during the enrollment interview ranged from 4 to 35 marks/wk. During the baseline phase of the study, however, the frequency of urine marking varied considerably from that estimated by cat owners during the enrollment interview. Twenty-nine owners overestimated the marking frequency. One owner estimated during the enrollment interview that the cat marked 21 times/wk, but the cat actually marked only 2 times/wk during the baseline phase. Nineteen owners underestimated the marking frequency, and 4 accurately estimated the marking frequency as recorded during the baseline phase.
Effects of environmental management—The number of urine marks recorded by the owners during week 1 was not significantly (P = 0.539; paired t-test) different from the number recorded during week 2. Similarly, the number recorded during week 3 was not significantly (P = 0.45; paired t-test) different from the number recorded during week 4. Therefore, data from the 2 weeks of the baseline phase were compared with data from the 2 weeks of the environmental management phase. Number of urine marks recorded during the environmental management phase (mean ± SE, 9.7 ± 1.3 marks) was significantly (P < 0.001; paired t-test) less than the number recorded during the baseline phase (11.7 ± 1.0 marks).

Forty cats (33 males and 7 females) marked ≥ 6 times during the baseline phase. For these cats, number of urine marks recorded during the environmental management phase (mean ± SE, 10.70 ± 1.50 marks) was significantly (P < 0.001; paired t-test) less than the number recorded during the baseline phase (12.93 ± 1.03 marks). Of the 7 female cats marking ≥ 6 times during the baseline phase, 5 (71%) were classified as having responded to environmental management (≥ 50% reduction in urine marking frequency during environmental management phase, compared with baseline phase), whereas only 12 of the 33 (36%) male cats were classified as having responded to environmental management. The percentage of females that responded was significantly (P = 0.003; ANOVA) higher than the percentage of males that responded. When data were analyzed only for those cats that marked ≥ 6 times during the baseline phase and lived in multicat households (30 males, 7 females), the proportion of females that responded with ≥ 50% reduction in urine marking frequency (6/7; 86%) was still significantly (P = 0.005; Fisher exact test) greater than the proportion of males that responded (5/30; 17%). There were too few cats from single-cat households to analyze response rates for these cats. In examining the proportion of cats in which marking frequency was reduced from ≥ 6 marks during the baseline phase to ≤ 1 mark during the environmental management phase, this occurred in 2 of 7 (29%) female cats but in only 2 of 33 (6%) male cats.

Discussion

Results of this study should help improve our understanding and treatment of urine marking behavior in cats. However, certain limitations of the study should be considered. Most importantly, owners of affected cats were recruited by use of newspaper advertisements and letters to veterinarians, and cats were enrolled in the study only if certain criteria were met, including the stipulation that cats from multicat households had to be the only cat in the household that was marking. Fulfillment of this criterion relied on the owner’s observations and the clinician’s judgment of the reliability of the owner’s observations, and it is possible that owners were mistaken in some instances. However, a recent placebo-controlled double-blind study of the effects of fluoxetine on urine marking in cats used the same method of evaluating owner observations with regard to determining which cat was marking. In that study, all treated cats had a ≥ 90% reduction in marking frequency, whereas none of the control cats responded to this degree, and the mean marking rate for control cats actually increased slightly. These results attest to the adequacy of relying on owner observations in this regard, because results would not have been this clear-cut if some cats that were believed to be urine marking had been misidentified. In addition, veterinarians in clinical practice must rely on owner observations when deciding which cat in a multicat household to treat for urine marking.

There were 5.7 times as many male as female cats enrolled in the present study, and male cats were significantly overrepresented relative to the pet cat population in California. This finding is in line with results of a previous study that found about twice as many of neutered males as spayed females started urine marking as adults. Although not as striking as the sex difference in cats meeting enrollment criteria, the present study also found that cats from multicat households were overrepresented, compared with those from single-cat households. This finding was also similar to previous findings. These data may be useful during preadoption counseling of clients.

Baseline daily observations of urine marking frequency were often disparate from frequencies estimated by the owners during the enrollment interviews. This suggests that in treating cats with urine marking behavior, owners should be given instructions to record each occurrence of urine marking behavior before and after initiation of treatment so as to adequately evaluate progress.

Information about causative factors reported by owners in the present study may be useful when advising clients about how to resolve existing problems. Again, this information relied on owner observations, but currently no other method is available for collecting such information for a large number of households with cats. Agonistic or unfriendly interactions with other cats outside the home or with other cats in the home were the 2 factors most commonly associated with the initiation or continuation of marking. If interactions with cats outside the home are a causative factor, then blocking windows where cats visually interact with outside cats may reduce the urine marking behavior. If interactions with cats inside the home are a factor, then making household arrangements to reduce the opportunity for agonistic interactions may prove useful in decreasing the frequency of urine marking.

Environmental management procedures used in the present study consisted of providing a sufficient number of litter boxes, scooping waste from litter boxes once a day, changing litter boxes weekly, and cleaning all urine marks with an enzymatic cleaner, as published data suggest that enzymatic cleaners result in the most effective removal of urine odors. These environmental management procedures alone significantly reduced the frequency of urine marking. However, among cats that marked ≥ 6 times during the baseline phase, females were more likely to respond to treatment (≥ 50% reduction in marking frequency) than were males. This suggests that the ambient level of urine or fecal odors may be more important in main-
taining urine marking in females than males. However, results of the study do suggest that attention to environmental and litter box hygiene can reduce marking frequency in cats, regardless of sex or household status of the cats, and may come close to resolving the marking problem in some cats.

References


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