



## Scent marking in shelter dogs: Effects of sex and age



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### ABSTRACT

Development of scent-marking behavior from the neonatal period to early adulthood has been well studied in dogs, but there is a distinct lack of information for older dogs. I studied scent-marking behavior during single walks of 500 male and female dogs at two shelters (Tompkins County SPCA and Cortland Community SPCA). My sample included juveniles, adults, and seniors. I found a significant effect of age on frequency of urination ( $P < 0.0001$  at both shelters): seniors urinated more frequently than adults (contrast significant at the Cortland shelter;  $P < 0.07$  at the Tompkins shelter), which urinated more frequently than juveniles. Age also influenced likelihood of directing urinations at targets in the environment ( $P < 0.0001$  at both shelters): seniors directed more of their urinations than did adults (significant at Cortland shelter only), which directed more of their urinations than did juveniles. I found that males urinated more frequently than females ( $P < 0.0001$  at both shelters) and directed more of their urinations ( $P < 0.0001$  at both shelters). Significant age and sex differences did not characterize defecation at either shelter. Ground scratching, whether after urination or defecation, was rarely performed by juveniles (% that ground scratched at least once: Tompkins shelter, <14%; Cortland shelter, 0%), so I excluded juveniles from analyses of this behavior. Ground scratching after urination was not associated with sex or age (adults versus seniors) at either shelter, but was positively associated with number of directed urinations (Tompkins shelter,  $P < 0.0001$ ; Cortland shelter,  $P < 0.002$ ). Ground scratching after defecation was not associated with sex at either shelter, but was associated with age at the Tompkins shelter ( $P < 0.03$ ; % that ground scratched after at least one defecation: 28% of adults; 42% of seniors); a similar pattern occurred at the Cortland shelter (29% of adults; 50% of seniors), but the association failed to reach statistical significance perhaps due to smaller sample sizes. Finally, at the Tompkins shelter, ground scratching after defecation was positively associated with number of urinations followed by ground scratching ( $P < 0.0001$ ); here, again, a similar pattern occurred at the Cortland shelter but the association failed to reach statistical significance. These data reveal new relationships between scent-marking behaviors; indicate that some marking behaviors continue to change even after a dog has reached adulthood; and highlight the differential effects of sex and age on urination, defecation, and ground scratching.

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### 1. Introduction

Scent marking with urine is sexually dimorphic in domestic dogs. Males urinate and countermark (mark on or near existing scent marks) more frequently than do females and direct more of their urinations at targets in the environment; typically, adult males raise a hindlimb to urinate whereas adult females squat (Beach, 1974; Bekoff, 1979a; Lisberg and Snowdon, 2011; Martins and Valle, 1948; Sprague and Anisko, 1973). Sexual dimorphism in urine-marking behavior has been reported for free-ranging dogs (Cafazzo et al., 2012; Pal, 2003), as well as for dogs maintained in either laboratory colonies or homes (Beach, 1974; Lisberg and

Snowdon, 2011; Martins and Valle, 1948; Sprague and Anisko, 1973). In contrast to urinary behavior, sex differences do not characterize either defecation (Sprague and Anisko, 1973) or ground scratching (backward scraping of the ground with the front feet, hind feet, or both performed by some dogs after urination or defecation; Bekoff, 1979a).

Development of sex differences in canine urinary behavior has been studied under laboratory conditions. Studies with beagles have shown that development of the adult male pattern depends on presence of testosterone around the time of birth (Beach, 1974; Ranson and Beach, 1985). Unmanipulated males (i.e., intact and receiving no hormone treatments) tested at 2–6 months (before puberty), 7–12 months (puberty reached by most males in the colony), and 13–15 months (early adulthood) displayed increasing frequencies of urination, investigation of vertical targets, target-

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oriented urination, and use of the raised-leg posture (Ranson and Beach, 1985). Males neutered about 1 week after birth showed significant delays in development of all aspects of the adult pattern whereas males neutered about 1 week after birth and administered testosterone for 2–3 months displayed precocious development of the adult pattern (Ranson and Beach, 1985). Although testosterone early in life is necessary for development of the adult male pattern of urine marking, two lines of evidence indicate that testosterone is not later necessary to maintain the pattern. First, males neutered as adults displayed marking behavior similar to that of intact adult males (Beach, 1974). Second, individual adult males tested before and after neutering showed no change in their marking behavior after surgery (Hart, 1974). Finally, when compared with male beagles, female beagles tested at the same maturational stages (before puberty; at puberty; early adulthood) exhibited relatively small increases in frequency of urination, target investigation, target-oriented urination, and the tendency to occasionally raise a hind foot off the ground while squatting to urinate (i.e., use the squat-raise posture; Ranson and Beach, 1985).

Most scent-marking studies of non-feral domestic dogs have included individuals of a single breed (e.g., beagles; Beach, 1974; Ranson and Beach, 1985; Sprague and Anisko, 1973; jack russell terriers; Wirant and McGuire, 2004; Wirant et al., 2007; Labrador retrievers; Lisberg and Snowdon, 2009, 2011). In many studies, sample sizes were small and individual dogs were observed over time (e.g., Beach, 1974; Bekoff, 2001; Ranson and Beach, 1985; Wirant and McGuire, 2004; Wirant et al., 2007). Additionally, although much is known about the development of scent-marking behavior from the neonatal period to early adulthood (Beach, 1974; Ranson and Beach, 1985), there is a distinct lack of information on the scent-marking behavior of older dogs. Indeed, Ranson and Beach (1985) stated that no systematic changes in urinary behavior of dogs occur after 15 months of age; however, no data on dogs older than 15 months were included to support their statement. Working with a sample of 12 female dogs, six of which were between 4 and 11 years old, Wirant and McGuire (2004) presented data suggestive of increased frequency of urination with age. Still, the study by Wirant and McGuire (2004) included only one senior dog, an 11-year-old female.

I used an approach different from those of past studies to examine sex and age differences in scent-marking behavior of domestic dogs. I scored behavior during single walks of a large number ( $n = 500$ ) of mostly mixed-breed dogs at two animal shelters. Dogs ranged in age from 4 months to 14 years, so the sample included juveniles, adults, and seniors. In a previous study of a subset of these dogs ( $n = 277$ ; Gough and McGuire, 2015), we investigated how likelihood of raising a hindlimb during urination varied with sex and age, and whether this behavior was lateralized (i.e., whether dogs preferentially raised the left or right hindlimb). Here, I focus on other measures of scent-marking behavior, including frequency of urination and occurrence of directed urinations, defecations, and ground scratching, and examine relationships among them.

Based on existing information (Beach, 1974; Bekoff, 1979a; Ranson and Beach, 1985), I predicted that scent marking with urine would be more frequent in males than females. Given the findings of Wirant and McGuire (2004) for older dogs and those of Ranson and Beach (1985) for younger dogs, I predicted that scent marking with urine would be most frequent in seniors, followed by adults, and then juveniles. Existing data suggest that, for most dogs, defecation plays little role in scent marking (Cafazzo et al., 2012; Sprague and Anisko, 1973), so I predicted that frequency of defecation would not vary in relation to sex or age class. Bekoff (1979a) found no significant difference in likelihood of ground scratching by adult male and female dogs (although values tended to be higher for males); thus, I predicted no sex difference in levels of ground scratching. Ground scratching is associated with social status in feral dogs (Cafazzo

et al., 2012) and wild canids (Gese and Ruff, 1997; Peters and Mech, 1975). In coyotes (*Canis latrans*), for example, alpha adults ground scratched more frequently than beta adults or yearlings, and pups were never observed to ground scratch (Gese and Ruff, 1997). Given the importance of social status, rather than age per se once adulthood has been reached in feral dogs and wild canids, I predicted that adult and senior dogs would not differ in levels of ground scratching. Finally, I predicted that juvenile dogs, like young coyotes, would show little, if any, ground scratching.

## 2. Materials and methods

### 2.1. Dogs and housing

I studied dogs during walks at the Tompkins County SPCA (hereafter called the Tompkins shelter;  $n = 331$  dogs) in Ithaca, NY, USA and the Cortland Community SPCA (hereafter called the Cortland shelter;  $n = 169$  dogs) in Cortland, NY, USA. The different sample sizes reflect my more frequent visits to the Tompkins shelter (two or three times a week) than to the Cortland shelter (once a week), which is located further from campus. Most dogs at both shelters were mixed breeds, either picked up as strays or surrendered by owners; some at the Tompkins shelter were transferred from other shelters. Veterinary staff examined each dog shortly after intake and performed the following: vaccinations; flea control; fecal exam and deworming; heartworm test; and any additional diagnostic tests deemed necessary. At the Tompkins shelter, screening blood work (e.g., complete blood count/chemistry profile) was routinely run for older dogs; urinalysis was run for dogs of any age when owners provided information at time of surrender about urinary issues or when symptoms of disease were observed in the shelter (e.g., frequent or infrequent urination, increased water intake, or blood in urine). Dogs at both shelters with known medical issues were not included in the study. Dogs without microchips received one (Tompkins shelter only), and intact dogs were scheduled for spaying or neutering. Shelter staff evaluated each dog's behavior using a series of tests (Bollen and Horowitz, 2008; Sternberg, 2006). All dogs had received veterinary care, undergone behavioral evaluation, and were on the adoption floor by the time we walked them.

Details of housing at both shelters have been described elsewhere (Gough and McGuire, 2015); I provide only a brief description here. Most dogs at the Tompkins shelter were housed individually in one of 13 cubicles, which ranged in size from 5.2 m<sup>2</sup> to 7.3 m<sup>2</sup>. Most dogs at the Cortland shelter were housed individually in three different rooms. The first room contained ten small cages reserved for very small dogs. The second room contained four runs that housed small to medium sized dogs. Dogs were most often housed in the third room, which contained seven cages, ranging in size from 2.3 m<sup>2</sup> to 4.5 m<sup>2</sup>. At both shelters, each cubicle or cage contained a water bowl, raised bed, and often a blanket and toy. Whereas dogs at the Tompkins shelter were walked by volunteers or staff several times a day, dogs at the Cortland shelter were more typically rotated through outdoor enclosures and walked occasionally by staff, volunteers, or potential adopters. Finally, dogs at both shelters were fed by staff each day between 08:00 and 09:00 h and again between 15:00 and 16:00 h.

### 2.2. Experimental procedures

All data were collected between February 16, 2013 and November 4, 2015, and all walks occurred between 11:00 and 17:00 h. I was present on every walk at both shelters, either handling the dog or collecting the behavioral data; undergraduate students trained by me assumed the alternate role. In relatively

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