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Observations of Scent-Marking and Discriminating Self from Others by a Domestic Dog (*Canis familiaris*): Tales of Displaced Yellow Snow

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KEYWORDS

scent-marking, canids, territorial behavior, olfactory communication

ABSTRACT

Little is known about what stimuli trigger urinating or scent-marking in domestic dogs, Canis familiaris, or their wild relatives. While it is often suggested that the urine of other animals influences urinating and scent-marking patterns in canids, this has not been verified experimentally. To investigate the role of urine in eliciting urinating and marking, in this pilot study I moved urine-saturated snow ('yellow snow') from place-to-place during five winters to compare the responses of an adult male domestic dog, Jethro, to his own and others' urine. Jethro spent less time sniffing his own urine than that of other males or females, and that while his interest in his own urine waned with time it remained relatively constant for other individuals' urine. Jethro infrequently urinated over or sniffed and then immediately urinated over (scent-marked) his own urine. He marked over the urine of other males more frequently than he marked over females' urine. The method used here can be extended to other species for which experimental data are lacking. Though based on one dog, these novel data may further our knowledge of the role of scent-marking in territorial behavior and of sex differences in territory acquisition and maintenance.

1. Introduction

Despite much interest in scent-marking by carnivores (Bekoff 1979a,b; Bekoff and Wells 1986; Gese and Ruff 1997; Allen et al., 1999 and references therein), there have been few experimental field studies of the phenomenon, and none such as the one described here in which clumps of urine-saturated snow ('yellow snow') were moved from one place to another to compare the responses of an individual to his own and others conspecific urine. Thus, little is known about urinating and marking behavior despite popular accounts that suggest otherwise, and there are few detailed field data concerning how free-ranging animals respond to their own and other conspecific urine.

The purpose of the present study was to investigate the role of urine in eliciting urinating and scent-marking in a male domestic dog, *Canis familiaris*, by using a new approach for free-ranging individuals (others have used 'yellow snow' experiments to investigate reproductive conditions and individual

discrimination of urine in captive canids (Brown and Johnston 1983; Mech et al., 1987; McCleod et al., 1996)). Tinbergen (1951/1989) stressed the importance of conducting simple field experiments. Moving yellow snow from place-to-place falls into this category. This type of experiment can also be used for other animals, and would yield important data concerning individual discrimination of their own and others' scents and its influence on urinating, scent-marking, and territorial behavior.

2. Methods

Data were collected from October to April 1995 and from October to April 1997–2000 between 06:00 and 09:00 when there was snow on the ground. Jethro, a 35 kg neutered male mix (predominantly German Shepherd and Rottweiler castrated at 9 months of age) who has never mated was observed as he sniffed his own and other dogs' urine while he walked freely along a bicycle path paralleling Boulder Creek, just west of Boulder, Colorado (USA). Jethro was 5.5–10.5 years of age during the course of this experiment. Immediately after Jethro or other dogs (known males and females) urinated on snow, I scooped up the clump of yellow snow (about 4 cm × 4 cm) in gloved hands while Jethro was elsewhere and did not see me pick it up or move it. Before picking up urine the gloves were cleaned thoroughly using clean snow to minimize odor cues. I kept track of which other dogs were present and did not use the urine of the same dogs for at least 1 week, and Jethro had not previously sniffed the other dogs' urine during a given session. After being moved, yellow snow was matted by hand into other snow to minimize visual cues.

It was impossible to know whether all dogs were intact (not castrated), but when I was able to gather this information by observing males or by asking the human(s) accompanying the dogs I learned that all but three males and five females were neutered. The urine of two females in heat was not used.

Yellow snow was moved so that Jethro arrived at the displaced urine: (i) within about 10 s (about 5–10 m down trail) of my placing it down; (ii) 10–120 s later (usually 10–50 m down trail); or (iii) 120–300 s later (more than 50 m down the trail). These intervals were chosen arbitrarily and might have to be changed for different experimental conditions. I also recorded the duration of sniffing (less than or greater than 3 s) using a stopwatch, whether Jethro urinated over the displaced yellow snow using the typical male raised-leg urination (RLU) posture, and whether or not he sniffed and then immediately urinated over the displaced yellow snow using the RLU posture. Sniffing immediately followed by directing urine towards a target is generally referred to as 'scent-marking' (Wells and Bekoff, 1981).

Data were analyzed using proportions tests (Bruning and Kintz, 1977, p. 222ff) that generate the *z* statistic. I used $P < 0.05$ (two-tailed test; $Z_{crit} > 1.96$) to indicate significant differences between two percentages. The phrase 'no significant difference' or similar terms means that $Z < 1.96$ and $P > 0.05$. Critical values of Z for other levels of statistical significance are 2.58 ($P < 0.010$) and 3.30 ($P > 0.001$).

3. Results

There were no differences in Jethro's behavior (the percentage of time he responded to different conditions) from year-to-year so data were pooled ($Z < 1.96$, $P = 0.05$). Data were also pooled for Jethro's responses to neutered and intact dogs for there were no differences in his response to the urine from dogs in either condition.

3.1. *Jethro arrived at displaced yellow snow within 10 s*

For this situation, Jethro's urine was moved 57 times, that of other males 38 times, and that of females 49 times (Table 1). Jethro paid significantly less attention ($Z > 3.30$, $P < 0.001$) to his own displaced urine (89.5% of his sniffs were < 3 s) than he did to the displaced urine of other males (18.8% of his sniffs were < 3 s) or to that of females (16.3% of his sniffs were < 3 s). There was no significant difference between

the proportion of sniffs that lasted for fewer than 3 s that were directed to the urine of other males or to the urine of females. Jethro urinated over or sniffed and then immediately urinated over (scent-marked) his own displaced urine significantly less ($Z > 3.30$, $P < 0.001$) than he did in response to the urine of other males or females. There were no significant differences between his marking over the urine of other males or females.

Table 1. A summary of the percentage of times in which Jethro sniffed his own ('own'), other males' ('males'), or females' ('females') displaced urine (yellow snow) for fewer than 3 s, urinated over it, or sniffed and immediately urinated (scent-marked) over it[a]

	Sniff < 3 s			Urinate over			Sniff and urinate over		
Arrives	**Own**	**Males**	**Females**	**Own**	**Males**	**Females**	**Own**	**Males**	**Females**
Less 10 s	89.5	18.8	16.3	21.1	86.8	77.6	8.8	26.8	24.2
N	57	38	49						
10-120 s	54.3	22.6	16.8	4.38	67.7	55.8	0	41.7	23.5
N	73	31	43						
120-150 s	44.3	22.9	15.4	14.8	86.4	77.0	3.8	31.6	11.5
N	61	22	26						

[a] The times listed under the column labeled 'Arrives' refer to the length of time it took for Jethro to arrive at displaced urine.

3.2. *Jethro arrived at displaced yellow snow 10 –120 s later*

For this situation, Jethro's urine was moved 73 times, that of other males 31 times, and that of females 43 times. Jethro paid more attention to his own urine than he did when he arrived sooner (a significant decrease in the proportion of sniffs that lasted < 3 s; $Z > 3.30$, $P < 0.001$), but there were no differences in his response to the displaced urine of other males or that of females in this situation when compared to his arriving sooner. He urinated over or sniffed and then immediately urinated over (scent-marked) his own displaced urine significantly less ($Z > 3.30$, $P < 0.001$) than he did in the other two situations (there were no significant differences between his response to the urine of other males or females). However, Jethro sniffed at and then immediately urinated over (scent-marked) the displaced urine of other males significantly more than he did the displaced urine of females ($Z > 3.30$, $P < 0.001$). Jethro never marked over his own urine in this situation.

3.3. *Jethro arrived at displaced yellow snow more between 120 and 300 s later*

For this situation, Jethro's urine was moved 61 times, that of other males 22 times, and that of females 26 times. Jethro paid slightly more attention to his own urine than he did when he arrived at the displaced urine within 10–120 s, but he continued to pay less attention to his own displaced urine than to others' urine. There were no differences in his response to the displaced urine of other males or that of females in this situation when compared to his arriving sooner. Jethro's pattern of urinating over the displaced urine of other males or that of females was very similar to that observed when he arrived at the displaced urine within about 10 s. However, he sniffed at and then immediately urinated over (scent-marked) the displaced urine of other males significantly more than he did the displaced urine of females ($Z > 3.30$, $P < 0.001$) although he did so in both instances less than he did when he arrived at the displaced urine within 10–120 s. Jethro rarely marked over his own urine in this situation.

4. Discussion

Moving yellow snow from one place to another was a useful method for learning about Jethro's patterns of urinating and scent-marking and how they were influenced by the presence of his own or other dogs' urine. Whether intact males or females would respond similarly is not known. Although Jethro was the only dog whose response to displaced urine was analyzed, this study is the first of its kind for a free-ranging animal and provided answers to questions that have previously not been studied experimentally in canids or other carnivores. In their pilot study of individual discrimination of urine in captive dogs and wolves, Brown and Johnston (1983) did not investigate the response of an individual to her or his own urine.

4.1. *Self and others*: *sniffing and urination patterns*

It is not surprising that Jethro clearly discriminated his own urine from other dogs' urine. There were notable differences in his behavior following his arrival at displaced urine that were influenced by the latency of his arrival and whether the displaced urine was his, that of other males, or that of females. Jethro paid less attention to his own displaced urine than he did to displaced urine from other males or females. In their study of the response of captive 6–11-year-old uncastrated male beagles to urine from other males, Dunbar and Carmichael (1981) reported that they spent almost twice as much time sniffing the urine from colony males (mean = 6.2 s) compared to their own urine (mean = 3.5 s). When Jethro arrived at 'yellow snow' within 10 s, about 90% of his sniffs directed to his own urine lasted less than 3 s. Brown and Johnston (1983) reported much longer sniffing durations by captive female beagles (as long as 30–40 s) and captive male and female wolves to conspecific urine (mean = 21 s to familiar urine and 46 s to unfamiliar urine). Sniffing durations of this magnitude were not observed in this study nor were they reported by Dunbar (1978) or Dunbar and Carmichael (1981) for the beagles they studied.

Jethro showed about the same amount of interest in displaced urine from other males and displaced urine from females as determined by sniffing duration. Jethro urinated over his own urine most frequently when he arrived at displaced yellow snow 10–120 s later. However, he urinated over the displaced urine from other males and that from females the least when he arrived within 10–120 s when compared to when he arrived within 10 or 120–300 s later. Regardless of when he arrived at the displaced urine, Jethro urinated over others' urine significantly more than over his own. Although there were no statistically significant differences between the percentage of time that he urinated over the urine of other males and the urine of females, in all instances he urinated over other males' urine more frequently than females' urine.

4.2. *Scent-marking behavior*

The differences in Jethro's response to the displaced urine from other males or from females are worth noting, especially when considering scent-marking behavior. Scent-marking is differentiated from merely urinating by a number of criteria that include sniffing before urinating followed by directing the stream of urine at urine that is already known to be present or at another target (where there might be urine; Wells and Bekoff, 1981). The behavior pattern that best differentiated Jethro's response to the urine of other males from his response to the urine of females was marking: sniffing and immediately urinating over the yellow snow. When Jethro arrived at the displaced urine either within 10–120 or 120–300 s later, he sniffed and then immediately scent-marked the displaced urine significantly more when it was from other males than when it was from females. Dunbar (1978) reported that captive male beagles spent more time investigating female urine than male urine.

Of course, more data are needed for additional individuals. It is not known whether wild canids show these patterns, but it usually is assumed that males are more responsive to the urine of other males than

to the urine of females especially during territory acquisition and maintenance Wells and Bekoff, 1981 and references therein). Although this is a pilot study, the method used can be applied as a model for other species and modified as needed. For example, the use of naïve observers who did not know from which individuals urine was taken could remove possible biases (perhaps unconscious cues) due to information to which knowledgeable observers were privy. Nonetheless, future research that involves relocating urine-soaked snow or dirt, combined with detailed observations of sniffing, urinating, and marking sequences, will help to elucidate what stimulates other animals to urinate or to scent-mark. This information can help us learn more about such topics as territorial behavior and sex differences in territory acquisition and maintenance.

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