



Factors affecting dog–dog interactions on walks with their owners

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ABSTRACT

Little is known about factors influencing dyadic interactions between dogs in public places. This paper reports on the effect of dog age, gender and size, human gender and the use of a leash on the occurrence of body sniffing, scent-marking, playing games, showing a threat and biting in canine dyads on walks with their owners. Observations of 1870 interacting dogs were made in public places where owners frequently walked their dogs. Dogs off a leash sniffed one another more often than dogs on a leash ($P < 0.001$). Males sniffed females more often than vice versa ($P < 0.05$) and than when dogs of the same gender sniffed one another ($P < 0.01$). Males marked more often than females when they encountered the same gender ($P < 0.05$) as well as the opposite gender ($P < 0.001$). Puppies played together more than twice as often as adults ($P < 0.001$) and eleven times as often as seniors ($P < 0.001$). The occurrence of play was seen more often between dogs of opposite genders than between males ($P < 0.01$). Small, medium and large dogs played with dogs of the same size more often than with dogs of different sizes. Threat appeared twice as often between dogs on a leash as between dogs off a leash ($P < 0.001$). Dogs of the same genders showed a threat nearly three times more often than dogs of opposite genders ($P < 0.01$). Males ($P < 0.05$) and females ($P < 0.01$) bit dogs of the same gender more than five times more often than dogs of the opposite gender. Dogs showed a threat more often ($P < 0.05$) and they bit another dog more than four times more often ($P < 0.05$) when both owners were men than when they were women. In conclusion, the dog age, gender and size, human gender and the use of a leash had a marked effect on dyadic interactions between dogs on walks with their owners.

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1. Introduction

Dogs are the most popular pets among people and are present in human societies all over the world. Many breeds of dog exist today and they vary considerably in physical appearance and temperament. These differences have arisen primarily from selective pressures imposed by humans to create dogs suitable for various roles (King et al., 2009). Dogs can be used for protection, rescue, hunting, and many other special purposes (Udell and Wynne, 2008). Physical inactivity in people is associated with preventable

lifestyle diseases such as cardiovascular diseases, type II diabetes and many other chronic diseases (Bauman, 2004). Walking is an easy physical activity that has many health benefits (Oka and Shibata, 2009). Dog ownership may be an effective tailored intervention among adults for promoting physical activity. The analysis of the relationships between dog ownership and leisure-time walking in adults revealed that dog owners spent more time in mild and moderate physical activities (Brown and Rhodes, 2006).

There are a number of factors affecting dog owners walking with their dog (Cutt et al., 2007). Moreover, not only motivators, but also constraining factors heavily influence the dog owners' decision-making process. Dogs may interact with other dogs and people when they are taken out of the house, on a walk (Westgarth et al., 2008). One

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of the most often barriers for dog owners who walk their dog frequently is their fear that their dog will be traumatized by an attack from another dog (Cutt et al., 2008). So far, little is known about the nature and frequency of contacts between dogs in public places (Westgarth et al., 2008). Bradshaw and Lea (1992) characterized the sequences of behavior that occur during interactions between dogs in popular walking areas, but did not evaluate the frequency of the interactions, because their sample of dogs was too small. Westgarth et al. (2010) focused on the use of a leash as a modifier of interactions between dogs and found that if either dog was on the leash, then the likelihood of interaction with another dog was reduced.

The objective of our study was to explore the occurrence of body sniffing, scent-marking, playing games, showing a threat and biting in dog–dog dyads on walks with their owners and to assess the impact of the dog age, gender and size, human gender and the use of a leash in modulating dog–dog interactions.

2. Methods

Dog–dog interactions were studied in the City of Brno (Czech Republic). Observations were made in thirty different areas of the city where owners frequently walked their dogs. Data were collected in local parks and other public places suitable for dog walking. Each of the thirty areas was visited once a month in the same time sequence from May to September 2009. Interactions between dogs were observed in the morning at approximately 6:30–9:30 and in the afternoon at approximately 16:00–19:00. These are time periods when owners most frequently walk their dogs in the City of Brno.

Only owners with one dog were chosen for observation. Owners with two or more dogs were not included in the study, because a dog can interact differently with one unfamiliar dog than with two or more unfamiliar dogs that belong to the same pack. Dogs walking with two or more persons were not chosen for observation, because the effect of the gender of the owner on the occurrence of dog–dog interactions was tested in the present study. Dogs that were observed without any sign of an owner were not included in the study, because in public places the interaction of a dog which has an owner and a dog which has no owner with another dog can be different. Females showing signs of proestrus or estrus and neutered dogs were excluded. The assumption was made that dogs and people walking together belonged to the same household.

Data were collected by direct observation. Only interacting dogs were observed. An interaction with another dog was defined as behavior of two dogs in physical proximity with attention focused on each other such as sniffing one another, scent-marking when meeting with another dog, playing one with the other, showing a threat and biting. The behavior of interacting dogs was recorded by one person. A standard procedure was used for all observations. Behavioral data were collected using a combination of focal-animal and all-occurrences sampling (Altmann, 1974). Dyadic interactions were recorded when they occurred at a distance of about 5–20 m from the observer. Data were collected from the first

interaction between two encountering dogs up to a maximum of 15 min. The observer did not affect the dog and owner behavior. Notes were taken by hand and later transcribed into an Excel spreadsheet.

The following behavior was recorded: sniffing another dog, scent-marking by urination, play, showing a threat and biting. Behavior was noted as body sniffing when a dog stopped walking and inspected the body of another dog with its nose. The meeting of two dogs immediately followed by directing urine toward a target was recorded as scent-marking (Pal, 2003). Behavior was recorded as a play when both participants were actively engaged in the play. A dyadic play was identified by the behavioral indicators of play outlined by Bekoff (1974, 1995), which include playful facial expressions, exaggerated movements and varied sequences of behavior. Canine behavior expressed by some of the following signs (curling of the lips, baring of the canine teeth, snarling or growling) was registered as a threat. Behavior was recorded as biting when a dog bit another dog. We assessed a threat and biting only in non-play contexts.

For each observation, the gender of the owner (male, female), age of the owner (child, adult), breed of dog (particular breed, crossbreed, unknown breed), age of dog (puppy, adult, senior), gender of dog (male, female), size of dog (small, medium, large) and the use of a leash were recorded. Dogs were classified as pure breeds based on the Fédération Cynologique Internationale (FCI) breed standards categories. The remaining dogs were classified as crossbreeds or unknown breeds (including some breeds that were difficult to identify accurately). Dogs were classified as small (less than 30 cm), medium (30–50 cm) and large (more than 50 cm) based on height at the withers as specified in the FCI breed standards. In breeds, for which the height at the withers is not specified in the FCI breed standards, and in crossbreeds or unknown breeds the size was classified subjectively based on dog description. Puppies, adults and seniors were distinguished visually. Dogs with juvenile morphology were classified as puppies. Adult dogs which showed signs of senescence (e.g., gray hair under the lips and around the nose with extension to the region of the eyes and to the forehead) were classified as senior dogs. The remaining dogs were classified as adult dogs. The owner accompanying the dog was asked to provide information in cases when age determination based on external morphological characteristics was unclear. In such a case, puppies were individuals less than 9 months of age in small breeds, less than 12 months of age in medium breeds and less than 16 months of age in large breeds (Pineda and Dooley, 2003). Adult dogs were individuals from 9–16 months (depending on dog size) to 8 years of age or females from first estrus to 8 years of age. Senior dogs were individuals over 8 years of age.

Statistical evaluation of the data was performed using the SAS software (SAS Institute Inc., Cary, NC, USA). Observations of 1870 interacting dogs which showed dyadic behavior were made in public places. We randomly selected one dog of each of 935 dyads as a focal animal and included in the analysis. The effect of dog age, gender and size, human gender and the use of a leash on the occurrence of body sniffing, scent-marking, play, showing a threat and

biting was analyzed using the chi-square test or Fisher's exact test. Differences between men and women in terms of their dogs (age, gender and size) were analyzed using the chi-square test. Results were considered to be significant for P values less than 0.05.

3. Results

The proportion of male and female dogs was 55% and 45%, respectively. Puppies, adults and senior dogs constituted 13%, 72% and 15%, respectively. The percentage of small, medium and large types of dogs was 30%, 25% and 45%, respectively. The Dachshund (9%) was the most popular small breed, the Cocker Spaniel (5%) of medium breeds, and German Shepherd (10%) and Labrador Retriever (8%) of large breeds. Of all the dogs 5% were classified as unknown breeds and 11% were determined as crossbreeds. Dogs were on or off a leash in 43% and 57% of the cases, respectively. Male and female owners represented 37% and 63% of the observations, respectively. A child was present in 5% of the observations. Men owned male and large dogs more frequently than women ($P < 0.001$). Women owned small dogs more frequently than men ($P < 0.001$). No significant difference in the proportion of male–female dyads was found when both owners were men than when they were women. The proportion of puppies, adults and seniors was nearly the same in male and female owners.

The effect of age on dyadic interactions between dogs in public places is shown in Table 1. Scent-marking was observed more often when seniors encountered one another ($P < 0.05$) than when adults or puppies encountered. Scent-marking was seen more often when puppies encountered one another than when puppies encountered adults ($P < 0.05$). Puppies played with one another more than twice as often as adults ($P < 0.001$) and eleven times as often as seniors ($P < 0.001$). Adults showed a threat to puppies nearly four times more often than vice versa ($P < 0.01$) and seniors showed a threat to puppies ten times more often than vice versa ($P < 0.01$). Adults ($P < 0.05$) and seniors ($P < 0.01$) showed a threat to puppies more often than to seniors. Puppies did not show biting behavior. The effect of dog age on scent-marking, play and showing a threat was also significant in the group of dogs off a leash. Based on these results, the effect of other factors on dyadic interactions between dogs was analyzed without puppies.

A dog sniffing another dog was observed in 75% of the interacting individuals. The occurrence of sniffing between dogs was influenced by the use of a leash, dog gender and size (Tables 2–4). Dogs off a leash sniffed one another more often than dogs on a leash ($P < 0.001$). Males sniffed females more often than vice versa ($P < 0.05$) and than when dogs of the same gender sniffed one another ($P < 0.01$). Large dogs sniffed small dogs more often than vice versa ($P < 0.05$). Sniffing was observed more often when small dogs encountered one another than when small dogs encountered large dogs ($P < 0.05$).

Scent-marking occurred in 32% of the interacting dogs. The occurrence of scent-marking was affected by the gender of the dog and of the owner (Tables 3 and 5). Males marked more often than females when they encountered the same gender ($P < 0.05$) as well as the opposite

gender ($P < 0.001$). Males marked more often ($P < 0.01$) when they encountered the opposite gender than the same gender. Dogs encountering another dog marked more often when both owners were women than when they were men ($P < 0.01$). The effect of the gender of the dog and of the owner on scent-marking was also significant in the group of dogs off a leash.

A play was seen in 26% of the interacting dogs. The occurrence of play was influenced by the use of a leash, dog gender and size (Tables 2–4). Dogs off a leash more often played with one another than when one or both dogs were on a leash ($P < 0.001$). The occurrence of play was seen more often between dogs of opposite genders than between males ($P < 0.01$). Small (toward medium dogs $P < 0.05$ and toward large dogs non-significantly), medium (toward small dogs $P < 0.05$ and toward large dogs non-significantly) and large ($P < 0.05$) dogs played with dogs of the same size more often than with dogs of different sizes. The effect of dog size on the occurrence of play was also significant in the group of dogs off a leash.

A threat was observed in 15% of the interacting dogs. The occurrence of threat was affected by the use of a leash and the gender of the dog and of the owner (Tables 2, 3 and 5). The occurrence of threat was more than twice as high between dogs on a leash as between dogs off a leash ($P < 0.001$). Dogs of the same genders showed a threat nearly three times more often than dogs of opposite genders ($P < 0.01$). Dogs showed a threat to another dog more often when both owners were men than when they were women ($P < 0.05$). The effect of the gender of the dog and of the owner on the occurrence of threat was also significant in the group of dogs off a leash. The German Shepherd showed a threat in 4% and 2% of the dogs owned by men and women, respectively. The Dachshunds showed a threat in 2% and 3% of the dogs owned by men and women, respectively. Other breeds showed a threat less frequently.

Biting was observed in 3% of the interacting dogs. Only one thirteenth of all biting was not preceded by a threat. The occurrence of biting was affected by the gender of the dog and of the owner (Tables 3 and 5). Males ($P < 0.05$) and females ($P < 0.01$) bit dogs of the same gender more than five times more often than dogs of the opposite gender. Dogs bit another dog more than four times more often when both owners were men than when they were women ($P < 0.05$). The German Shepherd showed biting behavior in 0.7% and 0.8% of the dogs owned by men and women, respectively. Other breeds bit less frequently.

4. Discussion

One dog sniffing another one was seen in three quarters of the interacting individuals in public places. This indicates that sniffing behavior has a key role in communication between dogs on a walk. The canine olfactory system is highly sensitive. Various body odors may permit individual identification during direct interactions between dogs (Simpson, 1997). Exchanges of olfactory information, in which one dog sniffs the head and anogenital area of the other, represented the majority of interactions (Bradshaw and Lea, 1992). Our results demonstrated that dogs on a leash sniffed one another significantly less often than dogs

Table 1

The effect of dog age on the percentage of dogs interacting with other dogs on walks, 935 dyads.

Dog age	Body sniffing	Scent-marking	Play	Threat	Biting
Puppy toward puppy	76.47%	29.41% ^{a,c}	73.53% ^{a,b,h,k}	2.94%	0.00%
Puppy toward adult	78.75%	10.00% ^{a,b}	50.34% ^a	6.25% ^e	0.00%
Puppy toward senior	76.47%	17.65%	20.59%	5.88% ^f	0.00%
Adult toward puppy	69.57%	24.64% ^b	50.34% ^b	24.64% ^{a,b,e}	2.90%
Adult toward adult	77.80%	30.45% ^d	30.84% ^{e,h}	13.16% ^a	2.75%
Adult toward senior	68.87%	33.02%	13.97%	11.32% ^b	4.72%
Senior toward puppy	58.82%	17.65%	20.59%	58.82% ^{f,g}	0.00%
Senior toward adult	61.64%	30.14%	13.97%	32.88%	5.48%
Senior toward senior	70.00%	50.00% ^{c,d}	6.67% ^{e,k}	16.67% ^g	3.33%

Values in the same column with the same superscript differ significantly (abcd: $P < 0.05$; efg: $P < 0.01$; hk: $P < 0.001$).**Table 2**

The effect of the use of a leash on the percentage of dogs interacting with other dogs on walks (without puppies), 718 dyads.

Lead	Body sniffing	Scent-marking	Play	Threat	Biting
Off-leash toward off-leash	83.82% ^{b,c}	29.45%	39.16% ^{c,d,e}	8.41% ^{a,b,c}	2.27%
Off-leash toward on-leash	71.13% ^b	36.08%	18.82% ^c	17.53% ^a	7.22%
On-leash toward off-leash	78.08% ^a	34.25%	18.82% ^d	19.18% ^b	2.74%
On-leash toward on-leash	64.02% ^{a,c}	31.80%	12.97% ^e	21.34% ^c	3.35%

Values in the same column with the same superscript differ significantly (a: $P < 0.05$; b: $P < 0.01$; cde: $P < 0.001$).**Table 3**

The effect of dog gender on the percentage of dogs interacting with other dogs on walks (without puppies), 718 dyads.

Dog gender	Body sniffing	Scent-marking	Play	Threat	Biting
Male toward male	67.73% ^e	30.45% ^{a,c}	20.00% ^{c,d}	20.91% ^{c,d}	4.55% ^{a,b}
Male toward female	84.14% ^{a,c,e}	45.37% ^{c,e,f}	30.14% ^c	7.49% ^{c,e}	0.88% ^{a,c}
Female toward male	75.78% ^a	23.44% ^e	30.14% ^d	8.59% ^{d,f}	0.78% ^{b,d}
Female toward female	70.63% ^c	18.88% ^{a,f}	23.08%	23.78% ^{e,f}	7.69% ^{c,d}

Values in the same column with the same superscript differ significantly (ab: $P < 0.05$; cd: $P < 0.01$; ef: $P < 0.001$).**Table 4**

The effect of dog size on the percentage of dogs interacting with other dogs on walks (without puppies), 718 dyads.

Dog size	Body sniffing	Scent-marking	Play	Threat	Biting
Small toward small	77.89% ^a	34.74%	29.47% ^a	17.89%	4.21%
Small toward medium	73.68%	26.32%	16.04% ^a	15.79%	0.00%
Small toward large	63.38% ^{a,b}	32.39%	19.42%	14.08%	1.41%
Medium toward small	77.94% ^c	38.24%	16.04% ^b	8.82%	4.41%
Medium toward medium	58.62% ^c	36.21%	29.31% ^b	17.24%	6.90%
Medium toward large	66.67%	24.36%	23.02%	17.95%	3.85%
Large toward small	82.35% ^b	38.24%	19.42% ^d	13.24%	1.47%
Large toward medium	75.40%	36.07%	23.02% ^c	11.48%	1.64%
Large toward large	82.87%	25.97%	34.81% ^{c,d}	16.02%	3.87%

Values in the same column with the same superscript differ significantly (abc: $P < 0.05$; d: $P < 0.01$).

off a leash. Similarly, Westgarth et al. (2010) reported that the use of a leash can reduce the number of interactions between dogs. A possible cause may be that some owners prevent their dogs to sniff other dogs and people. Nevertheless, not all dogs off a leash sniffed other dogs. We suppose that dogs do not always need a close contact for olfactory communication, because their sense of smell is very

powerful. Dogs can detect many odors at low concentrations and demonstrate remarkable odor discrimination (Lorenzo et al., 2003).

Results showed that males sniffed females more often. This indicates that males are more attracted by the odor of the opposite gender than of the same gender. Sniffing has an important role in canine sexual behavior. Males are

Table 5

The effect of owner gender on the percentage of dogs interacting with other dogs on walks (without puppies), 718 dyads.

Owner gender	Body sniffing	Scent-marking	Play	Threat	Biting
Man met man	69.23%	22.12% ^b	22.12%	20.19% ^a	6.73% ^a
Man met woman	75.30%	31.17%	24.32%	16.60%	4.05%
Woman met man	76.83%	28.05%	24.32%	18.29%	3.66%
Woman met woman	76.14%	36.49% ^b	28.42%	10.88% ^a	1.40% ^a

Values in the same column with the same superscript differ significantly (a: $P < 0.05$; b: $P < 0.01$).

able to determine if a female dog is in estrus by licking and sniffing at her urine, anal gland secretions and vulvar secretions (Root Kustritz, 2005). The domestic dog is a promiscuous species (Cafazzo et al., 2010). Males are receptive to an estrous female dog at any time of the year (Beaver, 1977). Results in the present study demonstrated that small dogs sniffed larger dogs less often than individuals of the same size. This may be associated with an overall tendency that smaller dogs were interested in interaction with larger dogs on a walk less often. In agreement with this finding, smaller dogs were less likely to approach a life-size dog replica of the model similar to a Labrador Retriever than were larger dogs (Leaver and Reimchen, 2008). We found that the age had no significant effect on the occurrence of sniffing behavior between dogs on a walk. This suggests that body sniffing has a similarly important role in dogs of all ages.

Scent-marking by urination near the place where dogs encountered each other on a walk was observed nearly in one third of the interacting individuals. This suggests that scent-marking behavior has an important function when dogs meet each other in public places. Urine deposits are used as odor information in canines. Females can communicate their reproductive status (Doty and Dunbar, 1974). Males may communicate their sexual and individual identity. Urine marks may also be used to denote territories and to mask the odors of other dogs (Simpson, 1997). The purpose of scent-marking may vary in different situations. On a walk males marked approximately twice as often as females. A higher rate of marking in males was also observed in the laboratory beagle (Sprague and Anisko, 1973) and free-ranging dogs (Fox et al., 1975; Bekoff, 1979; Pal, 2003). This indicates that scent-marking is probably more important for males than for females in their communication in public places. Moreover, the occurrence of scent-marking considerably increased in males when they encountered females. We suppose that a urine mark in this case may serve as a sign for a male where he encountered a female. This suggests that scent-marking has an important role in connection with sexual behavior in male dogs.

Results showed that seniors marked more often than puppies and adults when individuals of the same age encountered. Similarly, more frequent scent-marking by urination was observed in older than younger female Jack Russell Terriers during walks (Wirant and McGuire, 2004; Wirant et al., 2007). We assume that puppies marked less often, because their territorial behavior was not yet fully developed. In addition, the submissive position of puppies toward older dogs described in several studies (Beaver, 2009; Bradshaw et al., 2009) may also have an important role, because puppies marked less often when they encountered adults or seniors than puppies. It is known that puppies which were introduced to a pack of older dogs typically came in at the bottom of the social order (Beaver, 2009). On the other hand, a higher occurrence of scent-marking in seniors than in adults indicates that the importance of this behavior increases with the aging process of the dogs. This may be associated with a higher incidence of vision and/or hearing disturbances reviewed in several studies (Fischer, 1989; Glaze, 1997; Shimada et al., 1998; Ter Haar et al., 2010).

Our data demonstrated that neither the size of the dog nor the use of a leash had an effect on the occurrence of scent-marking. Thus, scent-marking by urination plays a similarly important role in dogs of all sizes and is independent of the use of a leash. Our results showed that dogs marked more often when both owners were women than when they were men. Simultaneously, women owned female dogs more frequently than men. As we described earlier, female dogs marked considerably less often than male dogs. Moreover, the proportion of dogs of all ages was similar in male and female owners. These findings suggest that dog marking may be influenced by the gender of their owners independently of the dog they own. A pet ownership was found to be positively associated with some forms of social contact and interaction (Wood et al., 2005). We suppose that the duration and/or frequency of social interactions may be different between male and female owners in public places, and therefore, the occurrence of scent-marking was higher when both owners were women.

Play was seen in more than one quarter of the interacting dogs on a walk. This suggests that playing is a frequent behavior when one dog encounters another dog in public places. The occurrence of play was significantly lower when one or both dogs were on a leash than when both dogs were off a leash. A possible cause may be that some owners prevent their dog to play with other dogs. One of the reasons is that playing dogs in some cases can resemble dog aggression. Dogs which play with each other can growl, show their canine teeth and bite. This can also be used during aggressive interactions. Therefore, dogs use a specific posture associated with the intention to play to be sure that the context that follows is not confused with other intentions, such as aggression (Beaver, 2009). A playing dog must communicate to its desired play partners that it is not trying to injure them (Horowitz, 2009).

Play between puppies was observed in more than two thirds of puppies which interacted with one another. This indicates that play for puppies on a walk has a similar, very important role as body sniffing. In puppies, the play behaviors mimic adult behaviors (fighting, sexual and predatory behaviors) in fragmented forms (Beaver, 2009). The occurrence of play between seniors was eleven times less often than between puppies. This may be caused by decreased locomotion activities described in senior dogs (Vaughan, 1990). Our findings showed that dogs on a walk preferred to play with individuals of the same size. This indicates that the body size of dogs has an important role in play initiation in public places. Similarly as in body sniffing, smaller dogs may be less inclined to get too close to larger dogs in public places. Moreover, play between dogs of unequal size may be too intimidating for smaller dogs due to the similarity between play and aggression.

Bauer and Smuts (2007) reported that female–female dyads were considerably more likely to play than male–male dyads in neutered adult dogs. On the other hand, our results showed that the occurrence of play in female–female dyads was similar as in male–male dyads in intact adult dogs. One of the possible reasons may be that neutering affects the dog's interest to play with another dog.

Threat was observed in less than one sixth of the interacting dogs on a walk. The occurrence of threat was minimal in puppies. On the other hand, adults and seniors most often showed a threat when they encountered puppies. This may be their negative reaction to the interest of puppies to play. This is indirectly supported by the fact that the occurrence of play between puppies was significantly higher than between puppies and older dogs.

The occurrence of threat was two times higher between dogs on a leash than off a leash. We suppose that the effect of the leash may have some connection with the pack behavior of dogs. Domestic dogs that display a threat on a leash possibly have a greater confidence in the very close presence of the owner. Another reason may be that the owners are responding to the presence of the other dog and some of them, in an effort to maintain control of their own dogs, are tensing up and tightening the leash. This response may therefore cause the dog to become more tense and perceive the other dog as a threat that triggers its aggressive behavior. In some cases, the dog on a leash may feel more vulnerable because it is unable to run away and may therefore show a threat when another dog gets too close. In contrast to a threat, the use of a leash had no effect on the occurrence of biting. Thus, the use of a leash can have a different effect on the occurrence of threat and biting in dogs in public places.

Dog biting another dog was observed in only 3% of the interacting individuals in public places. Moreover, these bites were mild and did not result in injury. Dogs displayed a threat that was not accompanied by biting more often than vice versa. This indicates that before they bite the majority of dogs warn with facial expressions, showing canine teeth and growling, and they bite only when this threat is not respected.

Dogs displayed a threat and biting to individuals of the same gender more often than to dogs of the opposite gender. We assume that this is associated with their territorial behavior. Dogs appear to exhibit territorial aggression as they defend a specific location from dogs which are not members of the family pack (Borchelt, 1983). Our results suggest that dogs on walks probably tolerate individuals of the opposite gender much more than the same gender if they belong to another pack.

The occurrence of threat and biting between dogs in public places was higher when both owners were men than when they were women. Similarly, Roll and Unshelm (1997) reported that dogs which bit another dog were owned predominately by men. Although men owned male and large dogs more frequently than women, male and large dogs did not show a threat and biting behavior more often than female and smaller dogs, respectively. Moreover, the proportion of male–female dyads was not different when both owners were men than when they were women. Similarly, there were no marked differences between men and women in terms of dog breeds which showed a threat and biting. This suggests that threat behavior and biting may be influenced by the gender of their owners independently of the dog they own. We propose that the occurrence of threat and biting in dogs on a walk may have some connection with aggressive tendencies and/or impulsivity in people. It has been reported in

several studies that men have more aggressive tendencies (Bettencourt and Miller, 1996; Archer, 2004; Hay, 2007) and impulsivity (Cross et al., 2011) than women. It is also known that dogs are able to perceive subtle messages of threat emitted by another dog (Beaver, 2009). Simultaneously, dogs are unusually skilled at reading human social and communicative behavior (Hare and Tomasello, 2005; Udell et al., 2010). Therefore, we suppose that dogs may be able to recognize aggressive tendencies and/or changes in impulsivity in their male and female owners. Another possible explanation may be that more aggressive tendencies and/or impulsivity in men than women may result in that male owners perhaps use confrontational training methods more frequently. It was found that the use of confrontational training methods was associated with a higher incidence of aggressive responses in dogs (Blackwell et al., 2008; Herron et al., 2009).

5. Conclusion

The most frequent interaction between dogs of all ages in public places was body sniffing, and furthermore, between puppies, it was playing. Thus on walks with owners, sniffing and playing behaviors in puppies, and sniffing behavior in adults and seniors are probably the most important interactions. In contrast, the least often occurring interaction between dogs was biting. Results also showed that different interactions between dogs on walks were influenced by different factors. The use of a leash and the age of the dog had the biggest effect on the occurrence of play and threat. The gender of the dog had the biggest effect on the occurrence of scent-marking and threat. The size of the dog had the biggest effect on the occurrence of body sniffing and play. The gender of the owner had the biggest effect on the occurrence of threat and biting. Further studies will be necessary to fully elucidate the dog–dog interaction behaviors in public places.

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