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JOURNAL TITLE: Learning and motivation

USER JOURNAL TITLE: Learning and motivation.

ARTICLE TITLE: Frequency and animal demographics of mouthing behavior in companion dogs in the United States

ARTICLE AUTHOR:

VOLUME: 74

ISSUE:

MONTH:

YEAR: 2021

PAGES: 101726-

ISSN: 0023-9690

OCLC #: 1755679

Processed by RapidX: 5/23/2021 9:30:46 AM

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Frequency and animal demographics of mouthing behavior in companion dogs in the United States

Mindy R. Waite^{a,b}, Michael J. Harman^c, Tiffany Kodak^{a,b,*}

^a Department of Psychology, University of Wisconsin-Milwaukee, 2441 E Hartford Ave., Milwaukee, WI, 53211, USA

^b Behavior Analysis Program, Marquette University, 525 N 6th St., Milwaukee, WI, 53203, USA

^c Department of Psychology, Briar Cliff University, 3303 Rebecca St., Sioux City, IA, 51104, USA

ARTICLE INFO

Keywords:

Canine
Bite
Problem behavior
Teething
Injury
Function

ABSTRACT

Problem behavior in companion animals can result in reduced quality or length of life for the animal, as well as stress for the human owners. In particular, mouthing is commonly described by dog owners as problematic (Shabelansky & Dowling-Guyer, 2016). However, there is a paucity of both descriptive and inferential data on the frequency or predictors of the behavior. The purpose of this study was to provide population-level data on mouthing behavior in companion dogs in the United States. Although there is known disagreement about the definitions of biting and mouthing behavior, mouthing was defined for this study as behavior where the dog's teeth or inner lips touch human skin or clothing. Data collected via surveys from dog owners indicated that a high percentage of the dog population engages in mouthing and that many owners find the behavior to be undesirable. Analyses indicated that the prevalence of this behavior is significantly correlated with age, although many dogs continue mouthing into adulthood. Additionally, the frequency and severity were also negatively correlated with age and owner desire to reduce the behavior. Future research should address disagreement on the labels and definitions of mouthing versus biting and experimentally assess efficacious interventions to reduce mouthing in young dogs and avoid mouthing in adult dogs.

1. Introduction

Although rarely addressed in the scientific literature, mouthing behavior is a common topic amongst dog owners, trainers, and behavior consultants because of owners' requests to reduce the behavior. Nevertheless, mouthing behavior has never been quantified in the general dog population using a formal operational definition, assessed for behavioral function, or evaluated for targeted, efficacious interventions. Furthermore, as a result of the paucity of an agreed upon operational definition or population-wide descriptive data, it is difficult to extrapolate the findings from the available research to the broader population. For example, [Gazzano et al. \(2008\)](#) suggested that 37 % of Italian dogs aged 11–18 months engaged in mouthing; however, the behavior was not defined, the data were from a small subpopulation, and the behavior was only measured as population frequency. Also unsubstantiated is the commonly held dogma that puppies and young dogs are more likely to engage in mouthing, as are breeds that frequently engage in behaviors with their mouths, such as retrievers ([Horwitz, 2018](#)).

Concerning the definition of mouthing, a literature search retrieved three descriptions of mouthing; however, two descriptions lack

* Corresponding author at: 525 N 6th St., Milwaukee, WI, 53203, USA.

E-mail address: tiffany.kodak@marquette.edu (T. Kodak).

the objectivity and technological precision necessary for reliable measurement. For example, Coppinger et al. (1987) defined mouthing as, “Chewing lightly on portion of animal; dog’s teeth do not usually puncture the animal’s skin” (p. 96) and identified mouthing as a subcategory of biting. Horwitz (2018) described mouthing as, “Oral contact with inhibited jaw pressure in an attempt not to inflict injury on another” (p. 805). Protopopova and Wynne (2014) offered a more precise operational definition, “Dog places teeth on person regardless of force” (p. 111), but did not actually measure the behavior in their population. Given the potential frequency and social significance of the behavior in the dog population, more research using precise operational definitions is necessary.

Because mouthing behavior results in direct contact between the animal’s teeth and the owner’s skin or clothing, the behavior may be problematic for both the owner(s) and the animal. For example, mouthing may cause pain and damage human skin or clothing (Shabelansky & Dowling-Guyer, 2016), which may have social and legal effects. Some people find dog mouthing behavior to be physically uncomfortable (Shabelansky & Dowling-Guyer, 2016), and this may be further compounded because the difference between dog mouthing and biting behavior is potentially unclear, as both behaviors have similar topographies (Coppinger et al., 1987; Guy et al., 2001; Oxley et al., 2019; Shabelansky & Dowling-Guyer, 2016) and unknown, possibly overlapping functions. Given the unclear delineation between mouthing and biting, owners of dogs who mouth on people could potentially face social ostracization or, in worst-case scenarios, legal action (Oxley et al., 2018). Concomitantly, dogs who mouth may also face negative outcomes including in-home confinement, relinquishment (Oxley et al., 2018; Patronek et al., 1996; Salman et al., 2000), or euthanasia (Kass et al., 2001; Lepper et al., 2002; Patronek & Dodman, 1999). In fact, 2.96 % of dogs relinquished to an Australian animal shelter for behavior problems were given up because of mouthing/nipping behavior, and “mouthy” behavior was cited as the reason for 7.54 % of behavior-based euthanasia in the shelter (Marston et al., 2005).

Despite anecdotal and descriptive evidence that dog mouthing behavior significantly impacts the lives of dogs and owners and is believed to be ethologically common, the prevalence, animal demographics, and actual impacts of dog mouthing are unknown. The purpose of this study was to provide a descriptive analysis of mouthing behavior in the US dog population. The study identifies the frequency of dog mouthing based on an objective and technologically precise operational definition, as well as correlations between the behavior and dog/household demographics, owner behavior, owner beliefs, and self-reported negative impacts on the owner’s well-being.

2. Materials and methods

2.1. Procedure

Surveys on dog mouthing demographics and behavior were developed and advertised on 29 dog-related social media groups (e.g., Love My Dog group; see Supplementary Material for survey advertising and questions) and on listserv posts to the American College of Veterinary Behaviorists (a listing of all groups is available from the first author). Breed- and behavior-specific groups (e.g., Labrador Retriever group or Dog and Cat Behavior Problems group) were excluded to avoid skewing the general, representative behavior distributions. For example, if Labradors as a breed inherently mouthed more frequently than other breeds, an overrepresentation of Labradors in the sample could suggest inaccurately high rates of mouthing. Owners were requested to complete a survey for each dog in their household, and, therefore, could take the survey multiple times. Survey questions covered dog mouthing and other relevant behaviors, dog demographics, owner behaviors, and owner beliefs. Owners were not provided any compensation for completing the survey.

The survey consisted of 32 questions in total, but each owner was presented with only a subset of questions based on response branching. For example, owners indicating on the first question that they were based outside the United States were immediately exited from the survey. The survey included an operational definition of mouthing. Dog mouthing behavior was defined as:

When the dog’s teeth or inner lips touch human skin or clothing. This excludes licking. Mouthing excludes biting, which is typically associated with other aggressive behaviors, such as growling, snarling, lunging outside of play. Mouthing is not typically considered aggression.

In contrast, biting people out of aggression was described as “typically occurs with growling, snarling, or lunging outside of play.”

The survey was developed and administered using Qualtrics version 2018 software (Qualtrics, Provo, UT), an online survey platform. The parameters of responses to questions varied across the survey; for some questions, owners were instructed to “select one” response (e.g., responses to “Does your dog ever mouth on people?”), whereas other questions allowed multiple responses (e.g., “How many dogs are currently in your household?”) or required a textual response (e.g., “Please briefly describe the intervention”). Accordingly, data from the surveys were extracted and reported as measures of central tendency (e.g., means and medians) for continuous variables or as frequency measures (e.g., overall and relative frequencies) for non-continuous variables. The survey was open for two months, by which time the response rate had dropped substantially, and 1066 unique surveys were either partially or totally completed.

2.2. Data analyses

Parametric (e.g., binominal logistic regression analyses) and non-parametric statistical analyses (e.g., Chi-Square Goodness of Fit and Chi-Square Test for Independence) were used to test null hypotheses. Binominal logistic regression analyses determined the extent to which continuous (e.g., age of dog) and non-continuous (e.g., breed of dog) variables significantly predicted classification across a dichotomous variable (e.g., mouthing status). Chi-Square Goodness of Fit analyses determined the extent to which an observed

frequency distribution (e.g., mouthing status) significantly differed from an expected frequency distribution. Expected frequency distributions were based exclusively on the number of potential categories and not on any a priori hypotheses. Chi-Square Tests for Independence analyses determined the extent to which a categorical variable (e.g., breed of dog) yielded significantly independent distributions across a separate categorical variable (e.g., mouthing status). Of those, 833 surveys were complete and used in statistical analyses. Statistical analyses were performed using SPSS version 25.

3. Results

3.1. Survey demographics

Surveys were submitted for 833 dogs ($N_{\text{Female}} = 387$) (Table 1), with each survey representing one dog. Owners submitted multiple surveys if they had multiple dogs in their home. The median reported age of the dogs at the time of the survey was 4 years, and the median age at the time of acquisition was 3 months. Participants reported acquiring dogs from shelters ($n = 365$), breeders ($n = 316$), family and friends ($n = 61$), pet stores ($n = 7$), and other sources ($n = 84$).

3.2. Mouthing population and age frequency

With respect to the prevalence of mouthing, the majority of participants reported that their dog currently mouths (45 %) or

Table 1
Demographics of the dog population analyzed.

Demographics	General Population		Mouthing Demographics					
	(n)	%	Currently Mouths		Previously Mouthed		Never Mouthed	
	(n)	%	(n)	%	(n)	%	(n)	%
Total	833		375	45.0 %	173	20.8 %	285	34.2 %
Sex^{NS}								
Female	387	46.6 %	162	41.9 %	82	21.2 %	143	37.0 %
Male	443	53.4 %	211	47.6 %	91	20.5 %	141	31.8 %
Current Age*								
<6 months	30	3.5 %	24	80.0 %	5	16.7 %	1	3.3 %
6–11 months	97	11.4 %	60	83.3 %	9	12.5 %	3	4.2 %
≥12 months	727	85.1 %	288	39.6 %	159	21.9 %	280	38.5 %
Mean (years):		4.0		3.4		4.8		7.0
Median (years):		4.9		2.1		4.0		6.8
Age at Acquisition*								
<6 months	502	60.7 %	235	47.0 %	128	25.6 %	137	27.4 %
6–11 months	97	11.7 %	35	36.1 %	23	23.7 %	39	40.2 %
≥12 months	228	27.6 %	97	42.5 %	22	9.6 %	109	47.8 %
Mean (months):		11.9		9.7		5.5		18.6
Median (months):		3		3		3		6
Acquisition Method^{NS}								
Shelter/rescue	365	43.8 %	152	41.6 %	75	20.5 %	138	37.8 %
Breeder	316	37.9 %	152	48.1 %	74	23.4 %	90	28.5 %
Friend/Family	61	7.3 %	24	39.3 %	12	19.7 %	25	41.0 %
Pet store	7	0.8 %	4	57.1 %	1	14.3 %	2	28.6 %
Other	84	10.1 %	43	51.2 %	11	13.1 %	30	35.7 %
Biting Behavior^{NS}								
Currently bites	70	8.4 %	43	61.4 %	11	15.7 %	16	22.9 %
Used to bite	49	5.9 %	22	44.9 %	10	20.4 %	17	34.7 %
Never bit	714	85.7 %	310	43.4 %	152	21.3 %	252	35.3 %
Plays Tug Games*								
Yes	572	68.7 %	273	47.7 %	133	23.3 %	166	29.0 %
No	261	31.3 %	101	39.1 %	40	15.3 %	119	45.6 %
Puppies in Litter^{NA}								
Mean:	7		6.9		7.0		6.2	

Asterisks indicate that the grouping variable yielded significantly ($p < 0.05$) independent distributions of mouthing status. “NS” indicates that the grouping variable yielded non-significant ($p > 0.05$) or non-independent distributions of mouthing status. “NA” indicates that the grouping variable was not assessed via statistical analyses.

previously engaged in mouthing (21 %). In contrast, very few dogs currently engaged in biting people (8 %) or previously engaged in biting (6 %); the majority of dogs had never bitten a person (86 %). There were no significant differences between the male and female dog distributions across the previously mentioned categories ($p > .05$).

A Chi-Square test for independence demonstrated that age-group (i.e., less than 6 months, 6–12 months, and older than 12 months) yielded significantly different distributions of dogs reported to (a) currently engage in mouthing, (b) have previously engaged in mouthing, and (c) have never mouthed ($X^2 = 78.616, p < .05, V = 0.22$). That is, dogs less than 12 months were more likely to currently engage in mouthing than other age groups, whereas dogs older than 12 months were more likely to have previously mouthed than other age groups. Furthermore, when dog age was assessed as a continuous variable, binomial logistic regression analyses determined that the age of the dog was a significant predictor of mouthing status (currently mouthing or not currently mouthing; $X^2 = 109.2, p < .001, \phi = 0.36$). Specifically, over 80 % of dogs less than 12 months of age were owner-reported to currently engage in mouthing, whereas there was a decrease in mouthing behavior as dogs aged beyond 12 months (Fig. 1). Nevertheless, 26 % of dogs over 5 years continued to mouth. Similarly, the age of acquisition also yielded significantly independent distributions across mouthing status ($X^2 = 41.73, p < .001, V = 0.16$), wherein dogs acquired at older ages were less likely to have previously mouthed and more likely to have never mouthed.

Owners indicated that 83 % of dogs who currently or previously mouthed began mouthing before 6 months-old (Fig. 2A). The majority of dogs began mouthing either before 10 weeks (38 %) or between 10 weeks to 6 months (45 %); few dogs started after 6 months. From the sample of dogs that had previously mouthed ($n = 153$), 0 % of owners reported that the behavior ceased prior to 10 weeks of age, 71 % reported that the behavior ceased prior to 1 year of age, and 29 % reported that the behavior ceased after 1 year of age (Fig. 2B).

3.3. Mouthing across breeds

Fig. 3 shows the frequency of mouthing across breed subpopulations that had data from at least 10 dogs per breed category. All breed groups were represented, with the most common being the sporting and herding groups. The most common pure breeds were Labrador retriever (5.4 %), golden retriever (5.0 %), and German shepherd (3.4 %). Mixed-breed dogs made up 39 % of the population. Although the general population and mixed-breed population had similar rates of mouthing (65.8 % and 67.6 %, respectively), breed differences were apparent. That is, a relatively higher percentage of the poodles currently or previously mouthed (92.3 %) compared to the general population, as did poodle mixes (86.4 %; labradoodles, goldendoodles, miniature goldendoodles, and Australian labradoodles). However, due to small population sizes in many breed categories, statistical comparisons were not feasible.

3.4. Frequency of mouthing versus biting

Because of the topographical overlap between biting and mouthing and the potential injuries resulting from mouthing behavior, it is possible that dogs categorized as engaging in mouthing were also more likely to be categorized as biting. To assess this, participants were asked about their dog's "biting" behavior. Whereas mouthing was defined by the presence of a behavior (e.g., mouth/teeth are touching skin or clothing), biting has a similar topography and was therefore defined instead by typically co-occurring behaviors of "growling, snarling, lunging outside of play" (Netto & Planta, 1997). Of dogs categorized as currently mouthing, the majority were also categorized as not currently engaging in biting, demonstrating that owners did discriminate between mouthing and biting behaviors. Nevertheless, dogs categorized as currently mouthing were over twice as likely to also be reported as currently biting. Specifically, 12.2 % of dogs who currently mouthed also currently engaged in biting, whereas only 6.2 % of dogs who previously or never mouthed also currently bit, suggesting either a topographical overlap of these behaviors or other correlation. Importantly, this finding is not

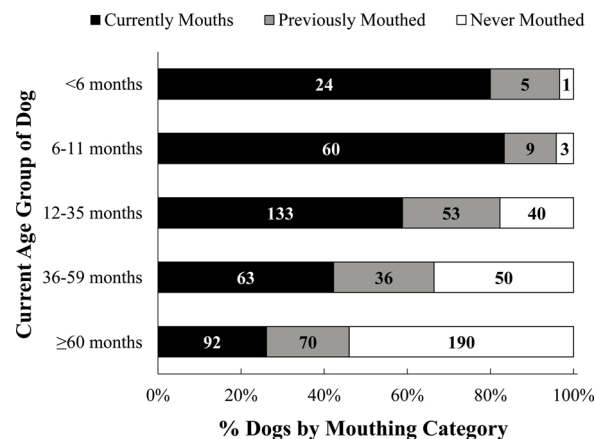


Fig. 1. Stratification of mouthing category by age group. Dogs were grouped by current age and further sorted by percentage of the group belonging to each mouthing category. Data labels indicate number of dogs in each group.

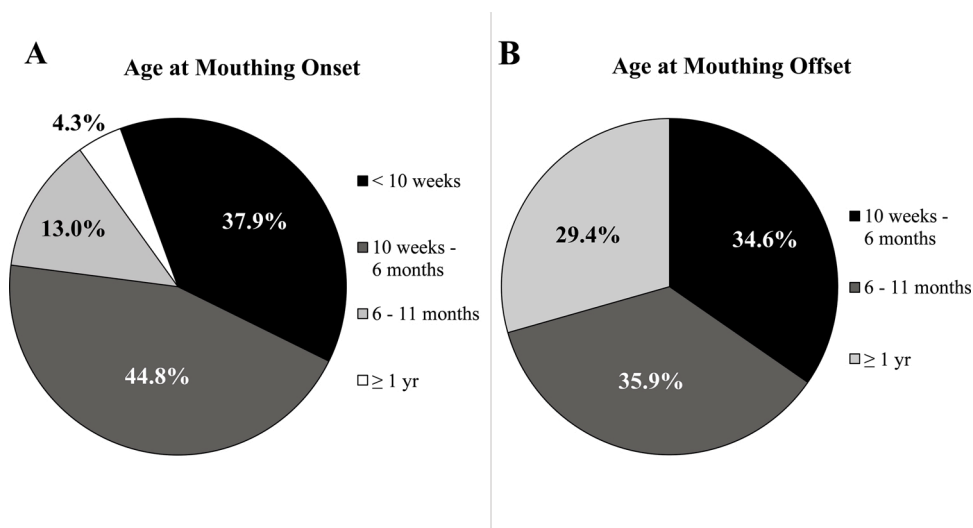


Fig. 2. Relative proportions of age at onset and offset of mouthing behavior. A) Percentage breakdown of age of onset of mouthing behavior in dogs which currently or previously mouthed. B) Percentage breakdown of age of offset of mouthing behavior in dogs who previously mouthed but ceased.

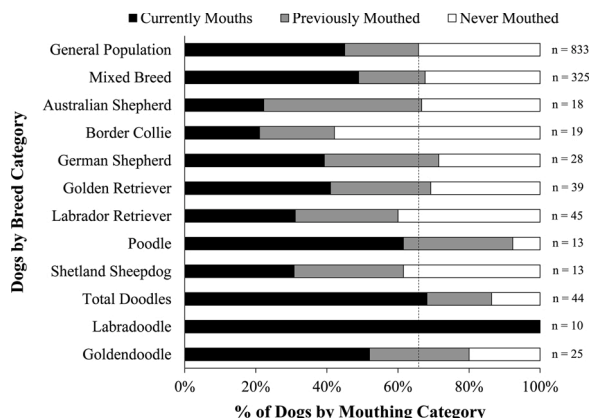


Fig. 3. Mouthing category by breed. “Total Doodles” includes all self-reported poodle breed mixes of goldendoodle, labradoodle, Australian labradoodle, and miniature goldendoodle. Dotted line marks the level of total mouthing history of the general study population.

indicative of a causal relationship between mouthing and biting, which was not evaluated in this study.

3.5. *Mouthing severity and effects on owners*

Fig. 4 displays the temporal frequency and severity of mouthing across age of dogs currently mouthing (Fig. 4A,C), as well as the owner’s desire to reduce mouthing across frequency and severity (Fig. 4B,D). Younger dogs engaged in mouthing at higher frequencies than older dogs ($X^2 = 62.15, p < .000, V = 0.19$). Specifically, 95.8 % of dogs under 6-months engaged in mouthing weekly or more frequently. In contrast, 29.3 % of dogs over 1-year-old engaged in mouthing monthly or less frequently. The frequency of mouthing behavior yielded significantly different distributions of owners desiring to reduce the behavior ($X^2 = 64.12, p < .000, \phi = 0.28$), with 94 % of owners wanting to reduce mouthing when it occurred on an hourly basis (Fig. 4B). For current mouthers, dogs in younger age categories were more likely to produce injuries ($X^2 = 32.47, p < .000, \phi = 0.20$). In general, dogs less than 6 months old were more likely to produce any type of injuries related to mouthing than dogs older than 6 months.

Owners reported over 71 % of mouthing dogs under 6-months-old caused injuries to people, whereas only 27.7 % of mouthers over 1-year-old caused injuries (Fig. 4C). The injuries that occurred were also more severe, in that a higher percentage of younger dogs caused punctures than older dogs. As severity increased, owners’ desire to reduce the behavior also increased (Fig. 4D). If the mouthing did not result in any injury, 48 % of owners indicated no desire to reduce the behavior. Overall, 60.5 % of owners desired to reduce their dog’s current levels of mouthing. Of those owners, 29.1 % had developed and implemented an intervention. Of owners whose dogs previously mouthed, only 38.2 % had developed an intervention to address the behavior. Owners who self-reported a desire to reduce the behavior were more likely to have also developed an intervention ($X^2 = 33.5, p < .001, \phi = 0.20$).

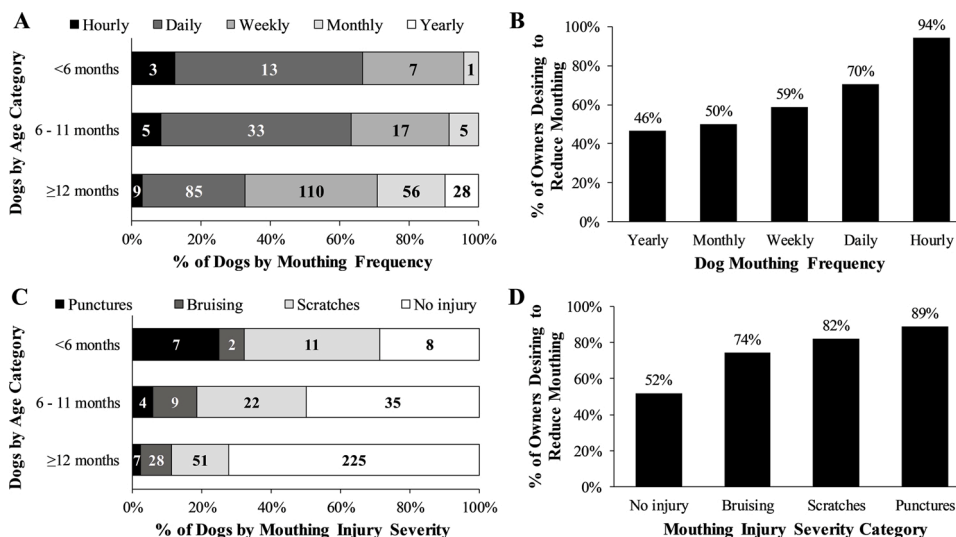


Fig. 4. Stratifications of mouthing frequency (A,B) and severity (C,D) are shown by dog age group and owner desire to reduce mouthing.

In addition to physical harm, mouthing also negatively affected owners' social activities. Owners of dogs that currently mouthed indicated that mouthing caused embarrassment (14%), reduced guests to the home (11%), prevented social outings (10%), worsened a human relationship (2%), or prevented travel (2%). Mouthing behavior also occasionally worsened the human/dog relationship (7%). Nevertheless, 63% of owners indicated that none of these were issues as a result of their dog's mouthing.

3.6. Mouthing contexts and proposed functions

Owners reported on the conditions in which the mouthing behavior was most likely to occur (Fig. 5A). Over 66% of dogs engaged in mouthing during play sessions with humans, and 52% mouthed during periods of excitement, such as the owner returning home or guests entering the house. According to owners, dogs were less likely to engage in mouthing during the presentation of aversive stimuli or when bored or tired. Owners were also asked to propose one or more functions (causes) of the mouthing behavior (Fig. 5B). The most commonly proposed function was automatic reinforcement, where mouthing was hypothesized to reduce physiological arousal while excited or frustrated (56%). The second most common function was access to owner attention (42%). Less commonly proposed functions included access to tangibles (e.g., to get a toy or chewable object), escape from an activity (e.g., nail trimming), and automatic reinforcement in the form of access to tugging, which could include a combination of both automatic and socially-mediated reinforcers.

3.7. Owner responses to mouthing

Owners reported their own behavior following the dog's mouthing (Fig. 5C) by listing all the responses in which they engaged when the dog mouthed. Many owners provided vocal attention in the form of a reprimand (57%) or raised voice (10%), and 24% provided physical attention in the form of shoving or moving the dog. Half provided access to tangible items. Fewer owners ignored the dog, walked away, blocked, or put the dog in a crate or separate room.

For owners proposing a single behavioral function, proposed functions were compared to the owners' mouthing-contingent behavior to determine whether owners' mouthing-contingent behavior matched the proposed function. Of owners proposing access to attention as the sole behavioral function, 60.6% provided some form of attention to their dog contingent upon mouthing. In contrast, only 16.9% ignored the dog or walked away. Similarly, of owners proposing access to tangibles (e.g., a toy or chewable object) as the single behavioral function, 80% said that they provided tangibles to their dog contingent upon mouthing. Similar owner responses were reported across owners of dogs that currently or previously mouthed, suggesting that either owners were inaccurate at guessing the function or that multiple variables may account for mouthing reductions in the past-mouthing group.

3.8. Mouthing and tug games

Because of the topographical overlap between playing tug games and mouthing and putative relationships between tugging and biting, owners were also asked whether they engaged in tug games with their dog. Dogs engaging in tug games were more likely to currently engage in mouthing than dogs who did not engage in tug games (47.7% and 39.1%, respectively) and were also more likely to have previously mouthed than not previously mouthed (23.2% and 15.3%, respectively). A Chi-Square test for independence found the distribution ratios of dogs currently or previously engaging in tug games to dogs not engaging in tug games were not significantly independent ($X^2 = 0.93, p > .05$) (Table 1). Given that groups that currently or previously mouthed have similar ratios of engaging in

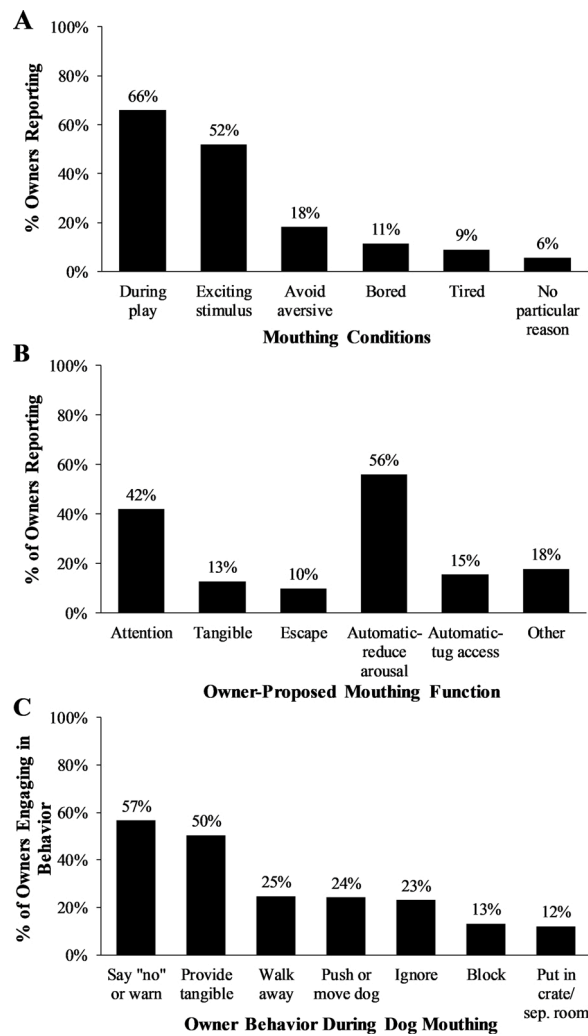


Fig. 5. Owner reports of conditions under which mouthing occurs (A), owner-proposed functions of mouthing behavior (B), and self-reported owner behaviors in response to dog mouthing (C).

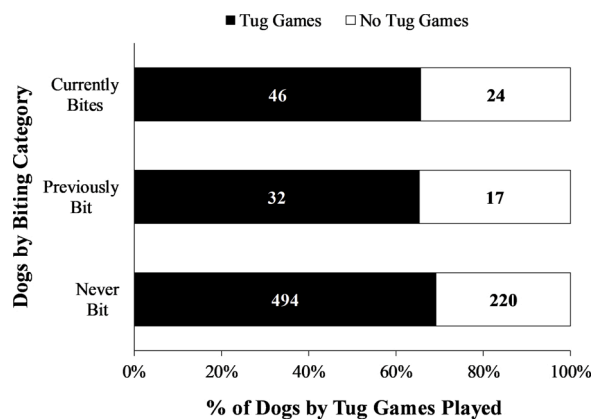


Fig. 6. Stratification of biting category by tug games played in household. Data labels indicate number of dogs in each group.

tug games, this suggests that tug games do not result in an increase in mouthing behavior perseveration. Additionally, dogs engaging in tug games were not more likely to bite or have previously bitten than dogs who did not play tug (Fig. 6) ($X^2 = 1.32, p > .05$).

4. Discussion

Results from this descriptive analysis based on owner reports suggest that mouthing is a common problem behavior in companion dogs. The methodology and results of the current study differ from similar, previous research in at least two ways. First, the current study collected data from 833 participants of varying canine demographics, whereas previous research (e.g., Gazzano et al., 2008) collected data from 43 participants all belonging to the same veterinary clinic. Thus, the findings of the current study may be more representative of the dog population in general. Secondly, this study found that the prevalence of dog mouthing is more common than previously reported in the literature (Gazzano et al., 2008). This finding may be the result of the inclusion of an operational definition of mouthing in the survey. Operational definitions precisely describe features and non-features of a behavior in order to allow for reliable and valid measurement of the behavior (Kazdin, 2011; Kimberlin & Winterstein, 2008). Because participants were provided a specific operational definition on which to base their reports, the findings from the current study may serve as a more accurate benchmark for the prevalence of dog mouthing in the general dog population.

Although mouthing was common throughout the dog population, many owners expressed a desire to reduce the behavior, especially as it became more frequent or medically severe. Further, 30 % of owners of currently mouthing dogs had implemented an intervention to reduce the behavior, yet their dogs continued to mouth, indicating inefficacy of owner-designed interventions. The most effective process for reducing a problem behavior is to empirically identify the function and develop function-based interventions (e.g., Iwata et al., 2013; St Peter et al., 2005; Thompson & Iwata, 2007). Owners indicated that mouthing was most likely to occur during human-dog play or when something exciting was happening, such as the owner returning home. This is consistent with the most common contexts for mouthing in a “highly-excitabile” subpopulation of dogs (Shabelansky & Dowling-Guyer, 2016). When owners proposed the function of mouthing for their dog, they typically listed several functions. However, large datasets on the function of problematic behavior in non-typically developing children suggest that only around 20 % of problem behavior is multiply-controlled (e.g., Beavers et al., 2013), suggesting that owners may not have accurately identified the behavioral functions, similar to human caregivers’ accuracy at identifying behavioral functions for children (Iwata et al., 2013). Additionally, even when owners identified a single function, owner behaviors in response to the mouthing were often contraindicated for the function they had proposed, meaning that the owner’s response to mouthing would likely worsen behavior with the proposed function. Together, these data suggest that a functional analysis, which empirically isolates the functions of a behavior (Iwata et al., 1994), should be used in place of owner prediction. Recently, a functional analysis was used to identify the function of mouthing behavior in three young dogs (Waite & Kodak, *In press*), and functional analyses have been used to elucidate the functions of other common dog behaviors (Dorey et al., 2012; Feuerbacher & Wynne, 2016; Hall et al., 2015; Mehrkam et al., 2020; Pfäller-Sadovsky et al., 2019; Winslow et al., 2018). Results suggested functions of access to owner attention and tangibles and identified efficacious, function-based interventions for each dog. However, given the frequency of mouthing across a wide variety of breeds, ages, and owner responses, future studies should compare functions and further test interventions for reducing mouthing across subpopulations.

Although some owners found mouthing to be an acceptable behavior not requiring reduction, mouthing behavior may be perceived as biting. While the two behaviors have topographical (Coppinger et al., 1987; Guy et al., 2001; Oxley et al., 2019) and potentially functional overlaps, behavior perceived as a bite may have serious or even lethal consequences for the animal (Marston et al., 2005; Salman et al., 2000). This topographical overlap was made clear in a study in which dog bite victims were asked to determine whether certain behaviors were considered bites (Oxley et al., 2019). Almost 50 % of subjects indicated that dog teeth touching clothing was considered a bite, and over half perceived skin contact by teeth with or without punctures constituted a bite. Similarly, two-thirds of dogs categorized as biters by their owners were later recategorized by a study team as having mouthed, but not bitten (Guy et al., 2001). As a result, even if mouthing does not produce visible wounds, it may still be considered biting by the public. Thus, it is in the best interest of both dogs and their families to reduce mouthing behavior.

In addition to the confusion regarding mouthing versus biting behaviors, mouthing had other negative impacts on owners, including impairment of both human-human and dog-human relationships. Other studies indicate that greater excitability in dogs was associated with higher owner frustration and worse perceptions of dog-owner attachment by the owner (Hoffman et al., 2013; Shabelansky & Dowling-Guyer, 2016). Here, the majority of owners indicated that dog mouthing did not result in problems for themselves; however, it is possible that the surveyed population did not include owners who perceived mouthing to have an extremely negative effect on their life, as those owners may have already relinquished such a dog. Further, inferential statistical analyses on these and owner behavior data were limited due to the owners’ ability to choose multiple, non-mutually exclusive responses in the survey.

The current study found no relationship with tug games and biting behavior, consistent with previous correlational studies (Klausz et al., 2014; Podberscek & Serpell, 1997), although in contrast to one study (Guy et al., 2001). However, these are the first data assessing correlations between tug games and mouthing. Specifically, we found no correlations between current or previous mouthing status and engagement in tug games, suggesting that tug games are not associated with the perseveration of mouthing. More likely, dogs who engage in mouthing are also likely to engaging in tug games with their owners due to matching behavioral functions; therefore, tug games can potentially be used as a reinforcer for an alternative behavior during mouthing interventions, consistent with previous intervention studies (Waite & Kodak, *In press*). In addition to showing a much higher prevalence overall, these data are also the first to suggest that mouthing behavior continues well into adulthood for a large subpopulation. The dogs studied in Gazzano et al. (2008) were young adults (11–18 months), whereas the present study included a wider age range of dogs and found that dogs over 5 years old continued to engage in mouthing, albeit on a more limited frequency and with less severity as age increased. This indicates

that many young dogs will engage in mouthing, and a subpopulation will contact reinforcement, thus maintaining the behavior into adulthood. As a result, future studies should potentially focus on identifying the function (cause) and interventions for mouthing behavior in dogs of different ages. Further, the function of mouthing and an effective intervention should be identified for puppies under 6 months in order to avoid maintenance into adulthood.

Given that the majority of young dogs engage in mouthing, it seems anomalous that relatively few adult dogs have never mouthed. However, this discrepancy could be explained by owners forgetting their dog's past behavior or by the dog's age at acquisition, wherein dogs acquired over 12 months of age are more likely to have never mouthed in their current home, possibly because they have stopped engaging in the behavior before adoption. This is consistent with dog acquisition data (not shown), which indicate that dogs adopted at older ages are more likely to have never mouthed than those acquired at younger ages. This also is consistent with other literature showing correlations between behavior problems and dog age (Pirrone et al., 2015; Takeuchi et al., 2001). This outcome suggests that owners who find mouthing to be highly aversive should contemplate acquiring older dogs, which are less likely to mouth, or assess dogs for their mouthing behavior before acquisition.

Mouthing was common across breeds, and results provide preliminary data suggesting possible breed differences. Specifically, poodles and poodle mixes (doodles) had higher rates of mouthing than other breeds assessed. However, given the small sample sizes, these data cannot be extrapolated to the general population and should be further explored. Additionally, these are correlational data and do not necessarily indicate that poodles or poodle mixes are more biologically prepared than other breeds to engage in mouthing.

These data were generated from large-scale surveys, which inherently have limitations. Although the survey description was kept vague to avoid skewing the population toward certain types of owners or dogs, it is possible that the results may not represent the general owner/dog population in the United States. It is also possible that owners have varying definitions of relevant behaviors. Previous studies demonstrated a wide variability in owner definitions of both biting and mouthing behaviors (Oxley et al., 2019) and, although this survey provided owners with specific definitions for each, owners' pre-existing definitions may have influenced their responses. The survey relied on owners' ability to recall information about their dog's behavior, which could further affect data validity.

Overall, these correlational data suggest opportunities for studying the functional relations between demographic variables, environmental contingencies, and mouthing behavior. This is especially important given the high frequency of mouthing behavior throughout the lifetime of companion dogs and the desire by owners to reduce the behavior.

5. Conclusions

Owner reports suggest that mouthing behavior is one of the most common problem behaviors throughout the companion dog population. Other common problem behaviors such as destructiveness, inappropriate elimination, coprophagy, barking, separation-related behaviors, and aggression occur at lower levels (Kobelt et al., 2003; Martínez et al., 2011; Salman et al., 1998). As such, dog mouthing is a highly socially relevant behavior that should be addressed through additional research on behavioral functions and effective interventions.

Acknowledgments

This work was supported by a John and Lynn Schiek Immediate Impact Research Scholarship (first author). The authors are grateful to the many dog owners who provided their data for the study.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.lmot.2021.101726>.

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