



Contents lists available at ScienceDirect

Journal of Veterinary Behavior

journal homepage: www.journalvetbehavior.com

Research

Owner reports on the use of muzzles and their effects on dogs: an online survey

Christine Arhant^{a,*}, Claudia Schmied-Wagner^b, Ursula Aigner^c, Nadja Affenzeller^d^a Institute of Animal Welfare Science, University of Veterinary Medicine Vienna, Wien, Austria^b Specialist Unit for Animal Husbandry and Animal Welfare, Wien, Austria^c Canis sapiens - gewaltfreies Hundetraining, Wien, Austria^d Division of Small Animal Internal Medicine, Department for Companion Animals and Horses, University of Veterinary Medicine Vienna, Wien, Austria

ARTICLE INFO

Article history:

Received 17 December 2019

Received in revised form

28 May 2020

Accepted 10 July 2020

Available online xxx

Keywords:

muzzle
 dogs
 muzzle training
 quality of life
 welfare
 dog bite prevention

ABSTRACT

Specific situations and legal requirements in some countries require dogs to wear a muzzle on a regular basis. Ongoing discussions within different national authorities are trying to balance the safety of the public against welfare of dogs when being walked. However, detailed information on an ideal type of muzzle, muzzle fit, introduction techniques to wearing a muzzle, and effects of muzzle use on the physical condition and behavior of dogs is very limited. Hence, this study collected data via an online survey on the frequency and circumstances of muzzle use and observed effects on dogs when wearing a muzzle by also incorporating training techniques and muzzle types used. Of 1,862 respondents, only 21.6% indicated their dog never wears a muzzle (average age: 5.8 ± 3.6 years). Around half of the owners stated that their dog wears a muzzle only when mandatory by legislation (47.8%) and/or when necessary to prevent a bite (47.5%). Public transport and crowded public places were situations where muzzles were used most often. Although basket-type muzzles (made of BioThane, plastic, wire) were used most often, only 71.3% reported a fit not clearly impairing dog welfare. The muzzle introduction technique (habituation, short training, intense training, no preparation) used significantly impacted on adverse behaviors observed when wearing a muzzle for the first time and on the ongoing behavior when muzzled such as trying to pull the muzzle off, rubbing the nose against objects, or freezing. Using food during muzzle training significantly decreased levels of passive avoidance during fastening and increased the likelihood of dogs actively putting their nose into the muzzle. Negative effects on the behavior when wearing a muzzle were reported by 19.6% of owners and labeled with the terms 'insecure, apathetic, dull, passive, distressed, anxious, unwell, agitated, nervous, tense, sad, or miserable.' Changes in the dog behavior were perceived as an advantage with respect to inability to access food (41.9%) and when used for veterinary visits (30.9%). Observed physical damage of either fur or skin and effects on thermoregulation and the ocular or gastrointestinal tract were reported by 161 (12.9%) owners. The results of this survey indicate a need to educate dog owners on muzzle fit and training protocols to reduce negative effects on dog welfare. In addition, potential alterations in intraspecies communication, other social behaviors, and welfare need to be explored in more detail.

© 2020 Elsevier Inc. All rights reserved.

Introduction

Every dog may face situations where wearing a muzzle becomes a necessity (e.g., visit to the vet, public transport, municipalities with muzzle regulations). A muzzle is more commonly recommended as part of the standard equipment for every dog, especially in countries with legislation specifying muzzles in public. Minimum requirements for muzzles are a good fit based on the size and shape of the dog's head, allowing the dog not only to drink, take treats,

* Address for reprint requests and correspondence: Christine Arhant Dr Med Vet, EBVS® European Veterinary Specialist in Animal Welfare Science, Ethics and Law, Institute of Animal Welfare Science, University of Veterinary Medicine Vienna, Veterinärplatz 1, 1210 Wien, Austria.

E-mail address: Christine.Arhant@vetmeduni.ac.at (C. Arhant).

and pant while wearing the muzzle but also prevent it from biting (Methling and Unshelm, 2002; Pike, 2018). However, wearing a muzzle can limit the dog's behavior in various situations. Oral behavior—such as investigation or manipulation with mouth and nose—is severely affected. The muzzle potentially restricts the dog during social interactions and explorative behaviors (Döring et al., 2008). Interspecies communication might be impeded, for example, when physically blocking facial expressions (Riedel, 2014). Most surprisingly, studies on effects of dogs when wearing a muzzle are scarce and merely based on short-term use. Police dogs, used to wearing a muzzle regularly, had lowered body positions but showed no increases in cortisol when tested over short time periods during work and training compared with being tested unmuzzled (Elsing, 2019). An observational study conducted during sessions of intraspecies social contact/play found dogs to be less active when wearing a muzzle (Elsing et al., 2011). Lower body postures and changes in activity can be interpreted as signs of discomfort or even stress (Hetts et al., 1992; Beerda et al., 1998, 1999). In addition to the initial decrease in activities when wearing a muzzle, Cronin et al. (2003) found a rebound effect, that is, an increase in activities, when removing the muzzle after a 48-hour period.

There are no published data yet on the effects of muzzles on dogs when wearing them regularly in public (e.g., during every walk), despite different mandatory legislative requirements already being in place in various countries. For example, the city of Vienna (capital of Austria, 1.9 million inhabitants) requires every dog to be either muzzled or on leash at all times when out in public (Anonymous, 2019b). Despite different legal requirements (even between states within Austria), dog owners' beliefs of when, where, with whom, and under what specific circumstances dogs should or should not need to wear a muzzle are critical to understand and act on, not only to maximize safety but also to ensure appropriate welfare for dogs if they must wear a muzzle.

Hence, the aim of this study was to collect data of dog owners' attitudes about the use of muzzles in dogs, what type of muzzle introduction protocols were implemented, and what the observed effects were by an online survey. Specific emphasis was put on the following:

- 1) Under which circumstances and how often do dog owners use a muzzle?
- 2) What type of muzzle, muzzle fit, and muzzle introduction technique is used?
- 3) What effects when wearing a muzzle have been observed on the behavior and on the physical condition of dogs?

This survey aims at gaining more knowledge on the effects of muzzles on dogs and their potentially negative impact on dog welfare/quality of life (QoL).

Material and methods

The questionnaire

To gain more insight on muzzle use and the effect of wearing a muzzle on the dog behavior and physical condition, a questionnaire comprising 53 questions/blocks of questions was developed (see Appendices 1 and 2: *The questionnaire was distributed in German-speaking countries, and therefore, the original is in German. We provide it in Appendix 1. In addition, we provide a translation in English in Appendix 2. The questionnaire also contains questions of which the results will be reported elsewhere.*). It included questions on demographics of dog owners (e.g., gender, age, country) and their dogs (e.g., sex, age, breed), questions covering more general aspects

of muzzle use such as the overall frequency of dogs wearing a muzzle, the type of muzzle used, overall fit of the muzzle, and how the dog was introduced to wearing a muzzle. The overall frequency of muzzle use was scored on a ten-point ordinal scale ranging from never to multiple times a day (1 = never, 2 = less than once a year, 3 = 1–3 × per year, 4 = 4–8 × per year, 5 = 9–11 × per year, 6 = 1–3 × per month, 7 = 1–3 × per week, 8 = 4–6 × per week, 9 = once per day, 10 = multiple times a day). The frequency of muzzle use in different everyday life situations was scored on a six-point scale (1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = very often, 6 = always). Several questions regarding dog behaviors when wearing a muzzle were asked: different behavioral expressions of the dog when wearing a muzzle for the first time were coded with a dichotomous scale (present/not present). Questions on current behavioral expressions observed when fastening or wearing a muzzle were scored on a five-point scale (1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = always). Questions on observed changes in dog behaviors when wearing a muzzle and the perceived advantages and disadvantages for daily life situations were initially scored on a seven-point scale but ultimately recoded to a three-point scale (disadvantageous, no effect/change, advantageous). For reporting negative effects (present/not present) on the dog behavior and physical condition, owners were able to fill in a free text field. Muzzle fit and the muzzle type were assessed by presenting pictures and asking people to choose the one most similar looking to the one that is currently used for their own dog. For muzzle fit, six drawings of dog heads wearing a basket-type muzzle varying in size were used (Figure). The depth (low, medium, high) and closeness to the dogs' nose (distance/no distance) were varied. A draft version of the questionnaire was tested for comprehensibility and adjusted accordingly, based on the comments of the respondents. On average, the revised final questionnaire took 15 to 20 minutes for completion. No question required an answer; therefore, the sample size differs according to the number of participants willing/able to answer a specific question. Sample sizes will be reported in the Results section.

The survey

The survey was performed as an online survey distributed via SurveyMonkey between March 6th and April 15th, 2019. It was advertised via social media, for example, Facebook account of the Vetmeduni Vienna allowing for a snowball effect and further spreading by word of mouth.

Data analyses

All statistical analyses were carried out using IBM SPSS Statistics, version 25. To group the items on the dog behavior during fastening and wearing a muzzle to subscale scores, we carried out two principal component analyses followed by a varimax rotation. Bartlett's test of sphericity was required to be significant, and the Kaiser-Meyer-Olkin criterion should be at least 0.6. To include items in the final solution, the anti-image correlation matrix diagonal was required to be at least 0.5. Subscales were required to have an Eigenvalue greater than one. An item was included in a subscale if it loaded with at least 0.3 on one subscale. If a double loading higher than 0.3 was present, it was only included if it loaded with at least 0.5 on one of the subscales. If this was the case, the variable was only used for calculating the score of the subscale on which it had a higher loading. The subscale scores were obtained by calculating the mean of the items in each subscale to facilitate interpretation. Items with negative loading were recoded before calculating subscale scores.

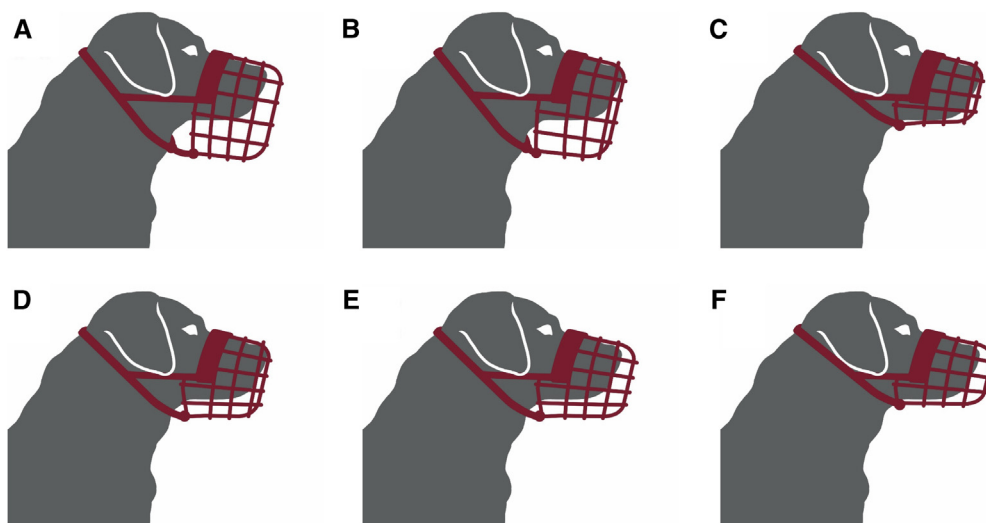


Figure. Pictures used to assess muzzle fit. (A) appropriate distance to nose and lower jaw; (B) no distance to nose, appropriate distance to lower jaw; (C) no distance to nose and lower jaw; (D) no distance to nose, small distance to lower jaw; (E) appropriate distance to nose, small distance to lower jaw; (F) appropriate distance to nose, no distance to lower jaw.

Relationships between the overall frequency of muzzle use and the living environment, muzzle fit, or negative effects of muzzle use were tested by using cross-tabulations and χ^2 tests. Only cells having standardized residuals (SR) > 2 or < -2 were considered to significantly differ from the expected frequency.

Effects of different muzzle introduction techniques on the dog's behavior when wearing a muzzle for the first time were explored using cross-tabulations and χ^2 tests. Effects of different muzzle introduction techniques on current behavior subscales when wearing a muzzle were assessed using the Kruskal-Wallis tests. Effects of using food were tested using the Mann-Whitney U-tests. For post hoc pairwise comparisons, the Mann-Whitney U-tests were used.

Free text answers describing negative effects of muzzles were inspected and categorized manually. Only effects that have been personally witnessed by the respondents were included in the analysis to prevent for anticipated but not observed effects to skew the results.

To find a balance between type 1 and type 2 errors, we corrected for multiple testing using the Bonferroni method in two clusters of tests. The goal was to reach an alpha level of 0.05 in each of the clusters. Cluster 1 included 4 tests testing a relationship with an overall frequency of the use of a muzzle. A P -value ≤ 0.0125 was considered significant. The second cluster was based on 16 tests related to effects of the type of muzzle introduction techniques and use of food on dog behaviors (9 variables for first time wearing a muzzle, 7 current behavior variables). Here, a P -value ≤ 0.003 was considered significant. This P -value was also considered significant for post hoc pairwise comparisons.

Results

Participants

Overall, 1,920 dog owners signed in to the survey. Participating dog owners were predominantly women (90%; 9.5% men; 0.5% nonbinary). The mean age was 38 ± 12 years (minimum: 14 and maximum: 78 years). Most dog owners lived in Austria (71.3%), 23.1% lived in Germany, and 4.9% in Switzerland. The remaining dog owners came from Lichtenstein, Luxemburg, Slovakia, the Netherlands, Italy, Spain, and Iceland. An academic degree was held by 37.1%. About one-third (33.7%) lived in big cities, 26.5% in small

towns, and 39.7% in rural areas. About one-quarter were first-time dog owners (22%). Almost half of the respondents (48%) owned one dog, 31% owned two dogs, and the remaining 21% owned three or more dogs.

Dogs

The dogs for which muzzle use (or nonuse) was reported ($N = 1,862$) were on average 5.8 ± 3.6 years old, and their average weight was 23.6 ± 11.2 kg. Half of the dogs were male (27.8% neutered male; 22.1% intact) and half were female (31.9% neutered female, 18.2% intact). Classification as a family dog (in contrast to working dogs) was made in 91.3%. The most common group were mixed breeds (28.3%) followed by American Staffordshire terrier (7.1%), Labrador retriever (5%), Australian shepherds (3.9%), 'other' breeds (3.2%), German shepherds (3.1%), bull terrier (2.8%), Belgian shepherds (2.8%), border collies (2.7%), Rottweiler (2.5%), Golden Retriever (1.8%). The remaining 36.9% were dogs of 153 other specified breeds.

Muzzle use and muzzle fit

In our sample, 21.6% stated that their dog had never worn a muzzle. Almost half of the owners reported that their dog wore a muzzle only when it was mandatory by legislation (47.8%), and 47.5% stated that their dog should wear a muzzle in specific situations to prevent bites. Participants reported that their dogs wear muzzles most often during public transport (average score often or

Table 1

Reported frequency of muzzle use in different circumstances (scale: 1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = very often, 6 = always)

Circumstance	N	Mean	SD
Crowded public areas, e.g., parks, pedestrian areas	1,474	2.37	1.77
Inns/cafes	1,462	2.03	1.76
Near schools/kindergartens	1,455	2.29	1.93
Dog parks	1,454	1.71	1.52
Public transport	1,454	4.73	1.94
During a veterinary examination	1,485	2.13	1.67
At home (only family members present)	1,478	1.07	0.39
At home (visitors present)	1,480	1.27	0.84
Noncrowded public areas, e.g., forest trails	1,481	1.58	1.26

very often—see Table 1). Crowded public areas such as parks and near schools or kindergarten were the second most common circumstance where respondents had their dogs muzzled (score seldom or sometimes). Least common is the use of a muzzle at home or in noncrowded public areas such as forest trails.

The reported average frequency of wearing a muzzle was significantly related to the environment in which the dog is kept (see Table 2). Dogs living in urban areas wear muzzles significantly more often than dogs living in small towns or rural areas ($\chi^2 = 152.38$, $df = 18$, $P < 0.001$).

The two most common types of muzzles used by the participants were soft polyurethane/polyvinylchloride (BioThane) basket muzzles (21.9%) and thermal rubber or silicone basket muzzles (21.6%). Other commonly used muzzle types were metal basket muzzles (20.3%) and standard plastic basket muzzles (18%). Leather basket muzzles (8.5%), ‘other’ types of muzzles (4.2%), and tube-type fabric muzzles (4.1%) were less common. Not owning a muzzle was reported by 1.3% of the participants ($N = 1,470$, reported only for dogs that wear muzzles).

Participants were asked to report muzzle fit for their own dog (see Figure). Picture E was chosen most often (49.9%, an appropriate distance to the nose and a small distance to the lower jaw), and picture A the second most often (21.4%, an appropriate distance to the nose with a largest distance to the lower jaw), respectively. The least often chosen were picture F (11.5%), B (7.7%), D (6.8%), and C (2.7%), respectively. Overall, 17.2% chose a picture where the muzzle was too close to the nose of the dog (pictures B, C, and D) and 14.2% chose a picture not allowing for mouth opening at all (pictures C and F). Long-term use of a muzzle (i.e., to wear a muzzle multiple times per day) was associated with more owners reporting a fit similar to picture A and B (largest distance to lower jaw; $\chi^2 = 28.29$, $df = 5$, $P < 0.001$, $SR = 3.1/2.6$, see also Appendix 3, Table A1).

Dog behaviors during muzzle use and preparing the dog to wear a muzzle

The owners were asked how they introduced their dog to wearing a muzzle. Of the participants ($N = 1,434$), 12.1% reported habituating their dog without the use of food by fastening the muzzle to the dog for several short periods (<1 minute; 6.7%) or several longer periods (e.g. 2 to 3 minutes; 5.4%), respectively. The use of a short muzzle training with food and fastening the muzzle to the dog on the same day was reported by 15.3% and a muzzle training with the use of tasty treats such as pasty (*paste-like food such as liver paté*) or peanut butter lasting over several days by 32.8%. Intense muzzle training lasting over several weeks with the use of tasty treats was reported by 25%. ‘Other’ methods were reported by 5.4% of the participants, and 9.3% reported neither habituation nor muzzle training (*‘dog was not prepared to wear a*

muzzle’). Regarding the use of food ($N = 1,416$), 12.4% stated that they never used food. The most common was the use of small pieces of cheese or sausage (26.4%), 24.4% used homogenized food such as liver/salmon pasty or peanut butter, 20.1% used soft dog treats, 6.5% used dry food kibbles, 5.7% small pieces of dried meat, and 4.5% other types of food, respectively.

In addition, participants were asked about the behavior of their dogs during fastening and when wearing the muzzle. Dog owners were asked whether during the first time when wearing a muzzle their dog showed a specific behavior or not. Half (50.5%) of the dogs remained calm and did not show specific reactions ($N = 1,361$). However, trying to use the paw to pull the muzzle off was also reported by 65.3% of the participants ($N = 1,362$). Other signs of being uncomfortable when wearing a muzzle were immobility/freezing (15.5%, $N = 1,313$), moving slowly/backward (15.4%, $N = 1,319$), panting (13.1%, $N = 1,316$), lying down (10.5%, $N = 1,318$), refusing to take treats (7.8%, $N = 1,315$), barking or whining (3.1%, $N = 1,310$), and growling (0.5%, $N = 1,311$).

At present, the most commonly observed behaviors (based on the mean values of a five-point scale) during fastening of the muzzle was the dog actively putting the snout in the muzzle but also turning the head away (see Table 3). Other behaviors possibly indicating avoidance were described less frequent with either to ‘freeze’/get stiff or to be agitated and run/jump around.’ Principal component analyses of dog behaviors during fastening of the muzzle resulted in three subscales explaining 55.5% of the variance (*‘passive avoidance during fastening of the muzzle,’ ‘active avoidance during fastening of the muzzle,’ ‘growling during fastening of the muzzle’*—see Table 3). When wearing the muzzle, the most common avoidance behaviors were trying to pull the muzzle off with the paw or rubbing the snout on the floor or on objects. Less common were freezing, refusing to take treats, or panting (see Table 3). Principal component analyses of dog behaviors when wearing the muzzle resulted in two subscales explaining 47.5% of the variance (*‘passive avoidance when wearing the muzzle’ and ‘active avoidance when wearing the muzzle’*—see Table 3).

For the purpose of comparing dog behaviors when wearing a muzzle for the first time, and during fastening and wearing a muzzle at present, with regard to the different types of introducing a dog to wearing a muzzle, we grouped both types of habituation (*‘short periods’ and ‘longer periods’*) and the two short muzzle trainings (*‘same day’ and ‘several days’*). The categories *‘intense muzzle training’ and ‘no preparation’* remained unchanged. ‘Other types’ of muzzle training were not included because of the various forms not clearly fitting in any other category. Only results significant after correction for multiple testing are presented in the main text ($P \leq 0.003$; see details of all other results in Appendix 3, Tables A2, A3, A4, A5, and A6). When wearing a muzzle for the first time, dogs whose owners reported the use of ‘habituation’ remained calm significantly less often ($\chi^2 = 16.40$, $df = 3$, $P = 0.001$, $SR = -2.3$). Attempts to pull the muzzle off with the paws and barking or whining were more common when habituation was used and less common when an intense muzzle training was used ($\chi^2 = 32.10$, $df = 3$, $P < 0.001$, $SR = 2.1/-2.3$; $\chi^2 = 14.53$, $df = 3$, $P < 0.001$, $SR = 2.5/-2.2$). For behaviors at present, the subscales *‘passive avoidance during fastening’ and ‘active avoidance when wearing the muzzle’* were found to differ significantly with respect to the category of the muzzle introduction technique used (see Table 3). For *‘passive avoidance during fastening’* all pairwise comparisons except *‘habituation’ versus ‘no preparation’* were found to be significantly different (all P -values < 0.001 ; see also Appendix 3, Table A5; habituation: mean \pm SD = 2.63 ± 0.98 , short training: 2.27 ± 0.91 , intense training: 1.99 ± 0.91 , no preparation: 2.64 ± 0.88). For *‘active avoidance when wearing the muzzle’* only two pairwise comparisons were significantly different (see also Appendix 3,

Table 2

Reported frequency of muzzle use with regard to the environment in which the dog is kept

Frequency of wearing a muzzle	N	Total, %	Urban, %	Small town, %	Rural, %
Never	403	21.6	13.3	24.2	30.6
Less than once a year	183	9.8	5.8	9.5	10.1
1–3 × per year	317	17.0	12.0	16.4	18.3
4–8 × per year	166	8.9	6.6	10.8	9.0
9–11 × per year	120	6.4	6.2	6.8	6.7
1–3 × per month	187	10.0	13.5	11.0	7.0
1–3 × per week	159	8.5	10.6	8.1	7.4
4–6 × per week	78	4.2	7.4	2.4	2.6
Once per day	61	3.3	5.0	2.4	3.1
Multiple times a day	188	10.1	19.5	8.3	5.1
Total	1,862	100	100	100	100

Table 3
Owner reports of dog behaviors during fastening and wearing a muzzle and effects of the type of muzzle introduction and the use of food for muzzle introduction

Dog behavior	Factor loading	N	Mean	SD	The type of muzzle introduction	The use of food
Dog behaviors during fastening of the muzzle						
Passive avoidance during fastening of the muzzle		1,384	2.26	0.94	<0.001	<0.001
Turns the head away or walks away	0.848	1,400	2.39	1.21		
Actively puts the snout in the muzzle	-0.830	1,399	3.03	1.36		
“Freezes”/gets stiff	0.670	1,388	1.43	0.93		
Active avoidance during fastening of the muzzle		1,375	1.22	0.38	0.021	0.105
Is agitated and jumps or runs around	0.708	1,384	1.35	0.80		
Barks and/or whines	0.608	1,386	1.05	0.31		
Pants	0.536	1,383	1.30	0.74		
Lies down	0.541	1,385	1.19	0.59		
Growling during fastening of the muzzle		1,387	1.01	0.14	0.096	0.463
Growls when the muzzle is fastened	0.845	1,387	1.02	0.16		
Growls when the muzzle is presented	0.841	1,387	1.01	0.17		
Dog behaviors when wearing the muzzle						
Passive avoidance when wearing the muzzle		1,324	1.28	0.59	0.029	0.755
Is immobile/freezes	0.842	1,337	1.35	0.84		
Lies down/does not walk	0.699	1,338	1.20	0.64		
Does not accept treats	0.654	1,334	1.31	0.85		
Walks slowly/stiff or backward/sideways	0.782	1,334	1.25	0.72		
Active avoidance when wearing the muzzle		1,323	1.59	0.50	0.001	0.555
Tries to pull the muzzle off with paws	0.667	1,351	2.43	1.20		
Rubs the snout on the floor or objects	0.679	1,352	2.43	1.18		
Unsettled, paces	0.698	1,337	1.24	0.66		
Pants	0.569	1,332	1.40	0.82		
Barks and/or whines	0.568	1,335	1.06	0.36		
Growls	0.307	1,335	1.02	0.17		
How often from 10 times fastening or wearing a muzzle...						
...the dog actively puts the snout in the muzzle		1,373	5.85	3.74	<0.001	<0.001
...the dog shows signs of feeling uncomfortable		1,335	4.97	3.61	0.001	0.887

P-values considered significant after correction for multiple testing are in bold print. The dog behavior was scored on a five-point scale: 1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = always.

Table A5): intense training led to lower levels of active avoidance behaviors than habituation ($P < 0.001$) and short training ($P = 0.002$; habituation: 1.74 ± 0.63 , short training: 1.61 ± 0.56 , intense training: 1.27 ± 0.60 , no preparation: 1.30 ± 0.60).

In addition, the dog behavior when wearing the muzzle for the first time, during fastening, and when currently wearing a muzzle was compared with regard to whether food was used or not used. The use of food was related to barking/whining when wearing a muzzle for the first time ($\chi^2 = 9.74$, $df = 1$, $P = 0.002$, but see also **Appendix 3, Table A3**) and to ‘passive avoidance during fastening’ (see **Table 3** and **Appendix 3, Table A5**). Dogs whose owners did not use food barked/whined more often when wearing a muzzle for the first time ($SR = 2.9$), whereas dogs of owners who used food showed lower levels of passive avoidance behaviors during fastening of the muzzle (answer yes: 2.23 ± 0.95 , “no”: 2.50 ± 0.89).

Furthermore, participants were asked how often (out of 10 times) the dog was voluntarily putting its snout into the muzzle and how often (out of 10 times) wearing the muzzle made the dog feel uncomfortable (**Table 3**). The category of muzzle introduction technique affected both parameters significantly. For putting the snout into the muzzle voluntarily, all pairwise comparison except ‘habituation’ versus ‘no preparation’ were significantly different (all *P*-values < 0.001 , but see also **Appendix 3, Table A6**). With an increasing effort in muzzle introduction/training, dogs were more willing to actively put their snout into the muzzle (habituation: 4.5 ± 3.4 , short training: 5.6 ± 3.6 , intense training: 7.6 ± 3.5 , no preparation: 3.6 ± 3.3). For signs of feeling uncomfortable when wearing a muzzle, pairwise comparisons showed that habituation led to more frequent signs than intense muzzle training ($P < 0.001$) and resulted in a statistical tendency compared with short training ($P = 0.007$; habituation: 5.9 ± 3.7 , short training: 5.1 ± 3.6 , intense training: 4.5 ± 3.4 , no preparation: 5.0 ± 3.8 ; see also **Appendix 3, Table A6**).

The use of food only affected actively putting the snout in the muzzle (**Table 3** and **Appendix 3, Table A4**): owners who used food

reported this behavior in six of ten times (6.1 ± 3.7) in contrast to only four of 10 times (4.0 ± 3.4) when no food was used.

Effects of muzzle use

Regarding the effects of wearing a muzzle on their dog’s behavior and the perceived impact on everyday life situations, more than half of the dog owners experienced “no effect/change” for all aspects except intraspecies interactions (see **Table 4**). During encounters with other dogs, muzzle use was perceived as having disadvantageous effects on dog behaviors in 37%, whereas one-fifth of the dog owners reported advantageous effects (20.7%). The greatest number of disadvantageous effects were reported for the dog’s interest in sniffing during walks (43.8%), and the greatest number of advantageous effects of muzzle use were reported for preventing access food/garbage (41.9%) and during visits at a veterinary clinic (30.9%).

Overall, 19.6% ($N = 244$ from 1,244 participants responding to this question) of participants reported negative effects on behaviors. Reported negative effects on behaviors were not related to the frequency of wearing a muzzle ($\chi^2 = 10.63$, $df = 9$, $P = 0.301$, **Appendix 3, Table A7**). A total of 229 participants answered the open question asking for observed effects on behaviors (see **Table 5**). Overall, 20 main topics were identified and categorized. Some answers (6.1%) were not assigned to a category because they were either unclear or could not be classified. The effects mentioned most often were ‘appears insecure,’ ‘appears apathetic/dull/passive on walks,’ ‘is limited in social interactions/communication,’ and ‘shows reduced activity/movement.’ Answers reported by only one or two participants included that ‘other dogs react differently,’ that the ‘time until defecation/urination is increased,’ and that the dog ‘shows atypical/unusual behavior’ (**Table 5**).

Most alarmingly, 12.9% ($N = 161$ from 1244 participants responding to this question) of participants reported negative

Table 4
Effects of muzzle use on dog behaviors and everyday life with the dog as perceived by dog owners

Context/behavior	N	Disadvantage, %	No effect/change, %	Advantage, %
Encounters with dogs	890	37.0	42.4	20.7
Encounters with familiar people	837	30.5	65.2	4.3
Encounters with unfamiliar people	916	18.8	64.4	16.8
Encounters with children	876	16.2	66.0	17.8
Visit at the veterinarian	799	15.1	53.9	30.9
Leash walking	960	26.4	66.0	7.6
Interest in sniffing	964	43.8	51.2	5.0
Ability to access food/garbage	938	5.1	53.0	41.9

effects of muzzle use on the physical condition of their dog. The frequency of negative effects on physical condition was dependent on the frequency of muzzle use ($\chi^2 = 76.17$, $df = 9$, $P < 0.001$, Appendix 3, Table A8). In particular, dogs that wear a muzzle multiple times a day have a higher incidence of negative effects on physical condition (31% of dogs, $SR = 6.5$). In total, 141 free-text answers could be categorized: effects of the muzzle on the fur (44%) were listed as broken hair, pressure marks, and alopecia and on the skin (34.7%) as wounds and abrasions. Impaired thermoregulation when wearing a muzzle was reported in 14.9% of dogs, and other effects related to the dog's eyes, gastrointestinal tract, or claws were reported by 6.4% of the owners.

Discussion

In recent decades, having dogs live in human environments and sharing human space has led to changes in legislation worldwide. Wearing a muzzle has become one of the required adaptations when dogs are living in proximity to humans, especially in urban areas (e.g., in public transport, crowded areas), in many parts of the world. Indeed, dog owners living in urban areas reported more frequent muzzle use. However, every dog may face situations where wearing a muzzle will greatly improve safety of the people involved (e.g., when brought to the veterinary clinic because of a painful condition). As such, it is surprising that, overall, only 78.4% of respondents from this study reported that their dogs have worn a

muzzle before. Around half of the owners stated that their dog only wears a muzzle if mandatory by law and perhaps most worryingly only half of the respondents think that there are circumstances in which their dogs should be muzzled to prevent a bite. This raises the question if owners actively refrain from muzzle use because they fear or have experienced negative effects on their dog's welfare and behavior. To the author's knowledge, this is the first study reporting and evaluating muzzle use, muzzle fit, and effects of muzzle use on dogs as perceived by their owners.

Muzzle fit and effects on physical condition

When asking about the muzzle that is most similar to the one that is currently used, only 71.3% reported a fit which is not clearly impairing the dogs' welfare. Legal requirements in Austria include fitting the muzzle to the dog's head shape and size and allowing the dog to drink and pant while wearing the muzzle (Anonymous, 2019a), a definition that is rather abstract and might lead to misconceptions of what that actually means. The ideal muzzle should therefore provide enough space between the tip of the nose (rhinarium) and the muzzle to prevent injuries on the glabrous and wet skin (Kröger and Goiricelaya, 2017) but also prevent the muzzle from being pushed into the eyes/orbital regions when the dog is sniffing something on the ground. However, not only the length along the dorsum nasi is important but also the depth (distance from the muzzle to lower jaw) to allow for full mouth opening to drink and pant and hence effective thermoregulation (Krönert and Pleschka, 1976; Goldberg et al., 1981). Most surprisingly, despite muzzle type A (shown in Figure) fulfilling these requirements in the closest to ideal way, only 21.4% reported this muzzle type to be used in their own dog. The most often used muzzle type (E) was ideal in the length but lacked sufficient space for full mouth opening. This muzzle fit can be acceptable for short-term use but is not appropriate if dogs have to wear muzzles over extended periods of time or during high performance (e.g., during high temperatures or intense physical exercise including play). Overall, a total of 28.7% of dogs wear a muzzle with inadequate fit, that is, either too short or so tight around the jaw that mouth opening is completely prevented. A strongly decreased ability for thermoregulation or injuries/pressure marks on the tip of the nose or the cheeks might be a consequence of wearing such badly fitted muzzles.

Of the 12.9% of owners who reported to have observed direct physical effects on their dogs, a high proportion reported pressure marks and injuries due to excoriation (fur (44%) and/or skin (34.7%)). These problems were also reported for dogs with a good muzzle fit regarding the two aspects assessed in this study (the distance to the rhinarium/depth). Unsurprisingly, a significant positive correlation when a muzzle is used multiple times a day with the occurrence of negative effects on the physical condition of its carrier was found, affecting 31% of dogs in this group. Although physical damage as a cause of inappropriate muzzle fit seems common knowledge, no previous study has reported data

Table 5
Categorization of the answers to the open question on observed negative effects on dog behaviors

Category assigned	Participants	
	N	%
Other dogs react differently	1	0.4
Time until the dog defecates/urinates is increased	1	0.4
Shows an atypical/unusual behavior	2	0.9
Sniffing is restricted/not possible	5	2.2
Avoids interaction with humans/dogs	5	2.2
Appears frustrated/unhappy	5	2.2
Effect on the physical condition	6	2.6
Is more aggressive/irritable	7	3.1
Other people perceive the dog as dangerous	8	3.5
Tries to pull of the muzzle/rubs the head on objects or people	9	3.9
Impact on training/obedience	11	4.8
Loss of joy/energy	13	5.7
Is limited/restricted in play behaviors, e.g. fetch	13	5.7
Appears sad/miserable	14	6.1
No classification possible	14	6.1
Appears unwell/agitated/nervous/tense	15	6.6
Appears distressed/anxious	17	7.4
Shows reduced activity/movement	18	7.9
Is limited in social interactions/communication	18	7.9
Appears apathetic/dull/passive on walks	21	9.2
Appears insecure	26	11.4
Total	229	100

indicating such a severe negative impact on dog welfare. Based on the results of this study, badly fitted muzzles, especially when used daily, represent a risk factor for the development of potentially painful injuries. Therefore, dogs required to wear muzzles, especially when wearing them on a frequent basis, have to be monitored regularly for negative effects on fur and/or skin and their muzzle fit adapted accordingly. This includes the muzzle to be free of (sharp) edges/ridges and have additional padding material where necessary.

Not only the fit but also the type and material of the muzzle used might lead to the observed physical effects. Although not common, 4.1% of dog owners reported the use of tube-type muzzles, which can affect thermoregulation capacities because of the inability of dogs to open their mouth if fitted in a manner to prevent a bite. However, such muzzles are less likely to cause local irritation because of their soft material. Despite that the use of these muzzles is only legally permitted for brief restraint, such as an injection during a veterinary visit, they are sold in pet shops in Austria. Hence, not only muzzle fit but also the muzzle type used might explain the unacceptably high incidence of impaired thermoregulation, as reported by 14.9% of owners observing effects on physical condition. To the authors' knowledge, no study has assessed the effects of wearing muzzles of different types and sizes on heat stress. Factors known to increase the risk of heat stress are high environmental temperatures, low ventilation (Flournoy et al., 2003; McNicholl et al., 2016), intense exercise, dehydration (Otto et al., 2017), the dog being dark colored (McNicholl et al., 2016) or having thick fur (Berglund et al., 2009), an increased body condition score, and being brachycephalic (Davis et al., 2017). We consider the use of inappropriate muzzles to increase the risk of suffering from heat stress and recommend using muzzles that impair neither full mouth opening nor air flow through the nostrils and mouth of the dog.

The use of basket-type muzzles of a different material was reported by most owners, which are considered acceptable from a welfare point of view (Pike, 2018). No specific type of material was correlated with observed negative effects. Most interestingly, 50.7% of all muzzles used were made of BioThane (soft polyurethane/polyvinylchloride), metal, or leather, materials that are rather expensive (the price range in Austria is between 50 and 100 euro). This suggests costs when buying a muzzle are not playing a role but a lack of education what a good fit for the individual dogs actually means is. Education campaigns such as providing leaflets on how to fit a muzzle in pet shops and in veterinary clinics (Arhant and Schmied-Wagner, 2019) and strongly supporting custom-made muzzles (e.g., BioThane, 3D print, leather) might mitigate these effects in the future.

Effects on the dog behavior

In addition to physical effects caused by muzzles, 19.6% of owners reported a negative effect on their dogs' behavior when wearing a muzzle. The term most often used to describe this effect was 'insecure' but also terms such as 'apathetic, dull, passive, distressed, anxious, unwell, agitated, nervous, tense, sad, and miserable' were used by around 40% of the dog owners reporting negative effects on their dog's behavior. Specific behaviors that were limited most often by muzzle use according to our respondents are social communication and interactions, activity, and movement and playing with the dog, in particular, fetch games. These findings match the results of a study using an antibarking muzzle where low ear, tail, and body postures and an increase in inactivity were found (Cronin et al., 2003). When using this terminology, one can argue that dog owners interpret their dog's behavior as experiencing a negative affective state when wearing a

muzzle, which also includes a change/inhibition of important social behaviors in certain situations. On the other hand, around two-thirds of the dog owners did not report changes in their dog's behavior during encounters with people or during leash walking. The perception of a change in the behavior when wearing a muzzle as an advantage or disadvantage varied according to the behavior in question. Regarding interest in the explorative behavior (sniffing the environment) (43.8%) and encounters with other dogs (37%) and familiar people (30.5%), observed behavior changes were more often perceived as a disadvantage. Again, these perceived changes in the explorative behavior and intraspecies and interspecies communication matched findings of reduced activities when wearing a muzzle (Cronin et al., 2003; Elsing et al., 2011) and difficulties when assessing facial expressions (Riedel, 2014).

Most interestingly, effects when wearing a muzzle during encounters with unfamiliar people and children were classed as disadvantage in 18.8% and 16.2% and as advantage in 16.8% and 17.8%, respectively. This distribution spectrum raises the question on how dogs wearing a muzzle are perceived by members of the public: do they feel more frightened indicated by a negative response toward the dog/owner or do unfamiliar people feel more secure and less anxious when encountering a dog wearing a muzzle in public. In addition to that, it is not known if an owner's and their dog's behavior changes because of this public perception and hence potentially influences social interactions.

The biggest advantage on the behavior of muzzled dogs was reported regarding the inability to access food/garbage (41.9%) and when visiting the veterinarian (30.9%). Both answers clearly indicate a concern for safety, on the one hand for the dogs themselves of not being able to ingest potential pathogens and on the other hand for the veterinarian to prevent a potential injury that might arise, for example, when examining an animal in pain. Pointing out these positive effects of a muzzle also in dogs without a known bite history, that is, increases in safety of all involved parties, could be used to increase adherence of owners to routinely train their dogs to wearing a muzzle from a young age on.

Training and training effect

Another aim of this study was to determine what type of muzzle introduction techniques have been used and how this might influence the dog behavior and welfare. Muzzle training with positive reinforcement is highly recommended (Horwitz and Pike, 2014; Pike, 2018) and indeed the technique used most often, with almost one-third of the participants using tasty food rewards to be associated with the muzzle over several days ('short training') and another 25% using the same technique over several weeks ('intense training'). However, almost one-quarter used either no training at all ('no preparation') or attempted to get the dog used to the muzzle over short periods of time (less than 3 minutes) without the use of food (classed as 'habituation') before wearing it over a prolonged period of time.

Unsurprisingly, intense training over several weeks turned out to be the most appropriate technique; it is significantly associated with owners reporting their dogs to bark/whine and trying to pull the muzzle off less often when wearing it for the first time. Furthermore, a significant reduction was found in behaviors categorized as active avoidance when wearing the muzzle, at present, such as rubbing the snout on objects, pacing, trying to pull the muzzle off with the paws, panting, or growling and of behaviors categorized as passive avoidance when fastening the muzzle, at present, such as freezing or turning head away/walking away. Moreover, dogs trained over several weeks voluntarily put their snout into the muzzle most frequent of all groups. Conversely, introduction techniques categorized as habituation seem to be less

efficient or even disadvantageous as dogs remained calm less often when wearing the muzzle for the first time and had levels of avoidance behaviors comparable to dogs that received no introduction to wearing a muzzle. These results are most likely not new knowledge for behavior experts in the field and experienced dog training professionals, but the relatively high percentage of owners not using introduction methods based on positive reinforcement (21.4%) indicates a lack of a basic understanding of the benefits of positive training methods. Indeed, the results of this study show the need of positive reinforcement techniques over a prolonged period to effectively reduce signs of distress, both in the short and long term. However, the amount of time and effort needed to successfully muzzle train a dog remains to be determined. Intense carrier training in cats (4 to 5 sessions per week with a total amount of 28 short training sessions over 6 weeks) resulted in reduced signs of stress during consecutive car rides (Pratsch et al., 2018). Although effective in a relatively short time period, this training intensity might be overwhelming for some owners. Fewer training sessions over a longer time period might also be advantageous as it has been shown that weekly training sessions are more efficient in terms of sessions needed until task achievement when compared with training five times a week (Meyer and Ladewig, 2008). However, experimental research on the optimal amount and frequency of training to effectively reduce signs of stress during muzzle use is lacking. Therefore, we see an urgent need to discuss the effects of different introduction techniques on welfare-relevant short-term and long-term behaviors with a wider audience, including professionals and dog owners and even more so for legal authorities to be able to make informed and state-of-the-art decisions. Another relevant consideration is that our self-selected sample was skewed toward female participants with a higher education level. In addition, they had to be willing to complete a rather long questionnaire. Presumably, our sample consisted mainly of quite committed dog owners. Aspects such as the choice of the muzzle type or training method used to introduce the muzzle may be different in other populations. Therefore, we cannot rule out a more pronounced negative effect of these aspects on dog welfare for the general population.

Methodological considerations—scales

For the overall assessment of the frequency of wearing a muzzle, a 10-point scale with reference to real time periods such as $1-3 \times$ per year or $4-6 \times$ per week (see Table 2) were used. Using 10 points allowed us to select reasonable time periods ranging from *never* to *multiple times a day*; however, 10- (and also 5-) point scales are preferred by questionnaire respondents and perceived to be easy and quick to answer (Preston and Colman, 2000). For the frequency of wearing a muzzle in different contexts and the frequency of specific dog behaviors during wearing a muzzle, scales labeled with “relative frequencies” such as *sometimes* or *often* were used. Using these “relative frequency” terms allowed for a gradation of muzzle use in different contexts and dog behaviors during wearing a muzzle independent of the overall frequency of muzzle use: assume a dog wears the muzzle one to three times a year; it is brought to the vet once a year and always wears the muzzle there; occasionally, it wears a muzzle in crowded public areas. Using the same scale as for the overall frequency, this dog’s owner would tick $1-3 \times$ to *three times per year* for the vet as well as for crowded public areas. With the “relative frequency” terms, the owner ticks *always* for the vet and *seldom* for crowded public areas. The answers are an interplay of how often the dog experiences a given situation and how often it wears a muzzle in this specific situation or how often a specific behavior can be observed when muzzled independent of how often the dog wears the muzzle. Using labels referring to real

time periods would give a completely different picture. However, when using these types of labels in a scale one, should always keep in mind that, for example, the term “sometimes” might have different meanings for different respondents in terms of real time periods. Furthermore, respondents were asked to rate wearing a muzzle in different contexts on a 6-point scale, whereas for dog behaviors during wearing a muzzle, a 5-point scale was used. As we considered the questions on muzzle use in different contexts to possibly induce a social desirability bias, a scale without a midpoint was chosen (Johns, 2005). In our survey, this meant that even if respondents were prone to tick in the middle of the scale, they had to decide whether their dog wears the muzzle sometimes (= 3) or often (=4) (Table 1). The only context that received average scores greater than 4 was “public transport,” in which muzzling a dog is mandatory by law in Vienna (the biggest city in Austria). In all other contexts, muzzle use is rather uncommon as they all received average scores less than 3. For dog behaviors, social desirability was not considered as influential; therefore, a 5-point scale was deemed appropriate (Table 3), as this is the preferred format regarding its ease of use by questionnaire respondents (Preston and Colman, 2000).

Muzzle use, QoL, and legislation

QoL describes individual experiences and associated mental states over time including multiple aspects such as health and the animal’s environment (Mellor, 2016; Yeates, 2016). Mental states experienced by a dog could be, for example, ‘excited playfulness’ during social play or ‘helplessness’ during muzzle use. The positive and negative experiences in an individual’s life are weighed against each other and a balance toward positive experiences constitutes ‘a good life’ or ‘a life worth living’ (for more information on these categories, see the study by Mellor, 2016). If negative experiences outweigh the positive ones, this may constitute ‘a life worth avoiding’ or even ‘a life not worth living.’ Taking into account the physical harm observed, but also including active and passive avoidance behaviors indicative of negative emotional states both in the short and long terms in this study population, one must ask the question about trends in legislative change, “does legislation by different authorities that requires permanent muzzle use reduce QoL of the affected animals?” This question is even more germane when puppies of breeds arbitrarily classed as ‘dangerous’ need to be permanently muzzled when being taken out into the public, as it recently happened in Vienna (Anonymous, 2019b). Based on the results of this study, if permanent muzzling is enacted, it should be a priority and is essential that dog owners are given sufficient time and competent advice to choose an appropriate muzzle and train their dogs in a manner that reduces stress associated with wearing a muzzle.

There is also an urgent need to assess permanent muzzle use in puppies and young dogs with respect to their social development, as it is known that social contact with humans and dogs is needed for proper development of puppy social skills (Appleby et al., 2002). Furthermore, all dogs should be given the opportunity for regular, outdoor access where they can display unimpeded explorative and play behaviors (Döring et al., 2008). Importantly, our participants’ answers to the open question on effects of muzzling on dog behaviors support the notion that wearing a muzzle may lead to behavioral inhibition and impedes certain behaviors such as exploring the environment or social communication and interaction. Dog parks/off-leash areas can be quite heavily used, making them suitable only for sociable dogs. These parks provide dogs with an opportunity for unrestricted exploration of the environment and engagement in intense social interaction such as intraspecific play. However, these parks and off-leash areas are less well suited for

dogs with intraspecific behavioral issues that are rooted in fear or anxiety. Dog parks/off-leash areas also limit certain activities such as owner-dog play involving toys, as they might induce some forms of aggression toward other dogs or their owners. In addition, visiting a crowded dog park may overwhelm both dogs (in particular puppies) and their owners especially if supervision of other unfamiliar dogs by their owners is poor. Mobbing situations can arise and negatively affect the development of intraspecific social skills. If dogs are required to be permanently muzzled in public areas and allowed to be unmuzzled and off leash in specific dog parks/off-leash areas, only, this will leave owners with less-social dogs that have no access to a garden or a large private outdoor area in a dilemma. When out in public, they will have to walk their dogs permanently muzzled, and in most situations, permanently kept on leash. According to our respondents, such restrictions might impede or even prevent exploratory behaviors during walks and lead to restrictions, for example, in owner-dog play activities such as fetch or tug-of-war games. Therefore, we consider impaired social skills and no access to a suitable private area for owner-dog play or more controlled dog-dog interactions as additional risk factors for a decrease in QoL if muzzling is mandatory in all public areas. In particular, mandatory muzzling of puppies is at risk for impairing the development of social skills and put these dogs at even higher risk for low QoL. Overall, but in particular in urban areas, it becomes more challenging for dog owners to provide their dog with opportunities for 'a good life' or 'a life worth living' if mandatory muzzling is enacted.

Conclusion

For most dogs, being able to comfortably wear a muzzle is an important skill. Muzzling can increase safety (e.g., by preventing bites), but there may also be benefits to the individual dog (e.g., reduced scavenging). However, choosing an appropriate muzzle and muzzle training using positive reinforcement techniques over a prolonged period of time are required to prevent negative outcomes. Negative outcomes can be both physical and emotional. Based on the results of this survey, permanent muzzle use as required in some countries likely affects social behaviors and decreases welfare/QoL in dogs. Further research into circumstances leading to negative effects of muzzle use in dogs, and how to prevent them, is of great importance.

Acknowledgments

The authors are very grateful to all participants of their study and to everyone who helped distributing the link of the survey.

Authors' contributions: The study was designed by Christine Arhant, Claudia Schmied-Wagner, Ursula Aigner, and Nadja Affenzeller. The data collection was carried out by Christine Arhant. The data were analyzed by Christine Arhant. The paper was drafted by Christine Arhant and Nadja Affenzeller. It was revised and critically discussed by Christine Arhant, Claudia Schmied-Wagner, Ursula Aigner, and Nadja Affenzeller. The final version was approved by all authors.

Conflict of interest

The authors declare no conflict of interest.

Ethical considerations

The study did not include live animals, and the ethics committee of the Medical University of Vienna and the University of Veterinary Medicine, Vienna, stated that the study did not require a vote.

Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jveb.2020.07.006>.

References

- Anonymous, 2019a. 2. Tierhaltungsverordnung, Anlage 1. Vienna. Available: <https://www.ris.bka.gv.at/GeltendeFassung/Bundesnormen/20003860/2.%20Tierhaltungsverordnung%2c%20Fassung%20vom%2011.12.2019.pdf>. Accessed December 11, 2019.
- Anonymous, 2019b. Wiener Tierhaltegesetz. Vienna. Available: <https://www.ris.bka.gv.at/GeltendeFassung/LrW/20000404/Wiener%20Tierhaltegesetz%2c%20Fassung%20vom%2011.12.2019.pdf>.
- Appleby, D.L., Bradshaw, J.W.S., Casey, R.A., 2002. Relationship between aggressive and avoidance behaviour by dogs and their experience in the first six months of life. *Vet. Rec.* 150, 434–438.
- Arhant, C., Schmied-Wagner, C., 2019. The appropriate muzzle for your dog. Vienna: Fachstelle für tiergerechte Tierhaltung und Tierschutz. Available: <https://www.tierschutzkonform.at/wp-content/uploads/tierschutzkonform.at-ftt-folder-theappropriatemuzzleforyourdog.pdf>. Accessed December 11, 2019.
- Beerda, B., Schilder, M.B.H., Van Hooff, J.A.R.A.M., De Vries, H.W., Mol, J.A., 1998. Behavioural, saliva cortisol and heart rate responses to different types of stimuli in dogs. *Appl. Anim. Behav. Sci.* 58, 365–381.
- Beerda, B., Schilder, M.B.H., Van Hooff, J.A.R.A.M., De Vries, H.W., Mol, J.A., 1999. Chronic stress in dogs subjected to social and spatial restriction. I. Behavioral responses. *Physiol. Behav.* 66, 233–242.
- Berglund, L., Endrusick, T., Yokota, M., Santee, W., 2009. Portable Protective Dog Enclosure and its thermal Effects on the Animal. 13th International Conference on Environmental Ergonomics, Boston, USA.
- Cronin, G., Hemsworth, P., Barnett, J., Jongman, E., Newman, E., Mccauley, I., 2003. An anti-barking muzzle for dogs and its short-term effects on behaviour and saliva cortisol concentrations. *Appl. Anim. Behav. Sci.* 83, 215–226.
- Davis, M.S., Cummings, S.L., Payton, M.E., 2017. Effect of brachycephaly and body condition score on respiratory thermoregulation of healthy dogs. *J. Am. Vet. Med. Assoc.* 251, 1160–1165.
- Döring, D., Mittmann, A., Schneider, B., Erthard, M., 2008. Genereller Leinenzwang für Hunde—ein Tierschutzproblem. *Deutsches Tierärzteblatt* 12, 1606–1613.
- Elsing, N., 2019. Die Auswirkungen des Maulkorb-Tragens auf das Verhalten und die Cortisolwerte von Polizeidiensthunden und die Reaktion von Passanten auf einen Maulkorb tragenden Hund. Doctoral, Ernst-Moritz-Arndt-Universität Greifswald.
- Elsing, N., Spitzley, I., Ganslosser, U., 2011. Der Einfluss des Maulkorbs auf das Verhalten des Hundes. 43. Tagung Angewandte Ethologie. Freiburg/Breisgau. KTBL.
- Flournoy, W.S., Wohl, J.S., Macintire, D.K., 2003. Heatstroke in dogs: pathophysiology and predisposing factors. *Compendium* 25, 410–418.
- Goldberg, M.B., Langman, V., Taylor, C.R., 1981. Panting in dogs: paths of air flow in response to heat and exercise. *Respir. Physiol.* 43, 327–338.
- Hetts, S., Derrell Clark, J., Calpin, J.P., Arnold, C.E., Mateo, J.M., 1992. Influence of housing conditions on beagle behaviour. *Appl. Anim. Behav. Sci.* 34, 137–155.
- Horwitz, D.F., Pike, A.L., 2014. Common sense behavior modification: a guide for practitioners. *Vet. Clin. North Am. Anim. Pract.* 44, 401–426.
- Johns, R., 2005. One size doesn't fit all: selecting response scales for attitude items. *J. Elect. Pub. Opin. Part* 15, 237–264.
- Kröger, R.H.H., Goiricelaya, A.B., 2017. Rhinarium temperature dynamics in domestic dogs. *J. Therm. Biol.* 70, 15–19.
- Krönert, H., Pleschka, K., 1976. Lingual blood flow and its hypothalamic control in the dog during panting. *Pflügers Archiv.* 367, 25–31.
- McNicholl, J., Howarth, G.S., Hazel, S.J., 2016. Influence of the environment on body temperature of racing greyhounds. *Front. Vet. Sci.* 3, 53.
- Mellor, D., 2016. Updating animal welfare thinking: Moving beyond the "Five Freedoms" towards "a Life Worth Living". *Animals* 6, 21.
- Methling, W., Unshelm, J., 2002. Umwelt-und tiergerechte Haltung von Nutz-, Heim-und Begleittieren. Georg Thieme Verlag.
- Meyer, I., Ladewig, J., 2008. The relationship between number of training sessions per week and learning in dogs. *Appl. Anim. Behav. Sci.* 111, 311–320.
- Otto, C.M., Hare, E., Nord, J.L., Palermo, S.M., Kelsey, K.M., Darling, T.A., Schmidt, K., Coleman, D., 2017. Evaluation of three hydration strategies in detection dogs working in a hot environment. *Front. Vet. Sci.* 4, 174.
- Pike, A., 2018. Managing canine aggression in the home. *Vet. Clin. North Am. Anim. Pract.* 48, 387–402.
- Pratsch, L., Mohr, N., Palme, R., Rost, J., Troxler, J., Arhant, C., 2018. Carrier training cats reduces stress on transport to a veterinary practice. *Appl. Anim. Behav. Sci.* 206, 64–74.
- Preston, C.C., Colman, A.M., 2000. Optimal number of response categories in rating scales: reliability, validity, discriminating power, and respondent preferences. *Acta Psychol. (Amst.)* 104, 1–15.
- Riedel, K., 2014. Niedersächsischer Wesenstest seit Abschaffung der Rasseliste von Oktober 2003 bis März 2013. Doctoral Doctoral, Tierärztliche Hochschule Hannover.
- Yeates, J., 2016. Quality of life and animal behaviour. *Appl. Anim. Behav. Sci.* 181, 19–26.