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1 **Short Communication**

2

3

4 **The effects of dog appeasing pheromone spray upon canine vocalizations and stress**
5 **related behaviors in a rescue shelter**

6

7

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19

20 **Abstract**

21 Exposure to dog appeasing pheromones (DAP) has been suggested to reduce stress related
22 behaviors in dogs; however, the effects of DAP administered using a portable, rapid use spray
23 has not received as much attention as the plug-in format. The aim of the present study was to
24 determine whether DAP spray reduced stress related behaviors in rescue shelter dogs (*Canis*
25 *familiaris*). Barking intensity, frequency of barking and stress related behaviors in the presence
26 of a stressor were recorded using a repeated measures design with and without the use of spray
27 pheromones. The mean barking intensity was reduced in dogs exposed to DAP spray although
28 no significant difference in the frequency of barking or occurrence of stress related behaviors
29 was found. This change in barking behavior is difficult to interpret as being beneficial to dog
30 welfare, due to the lack of support from a reduction in the other stress indicators. Further
31 research is needed which utilizes both a longer time period of DAP exposure and behavioral
32 observation to understand any effects of DAP on dogs' behavior. A larger sample size,
33 alongside use of different stressors and physiological stress indicators, should also be
34 considered.

35

36 *Keywords:* Dog Appeasing Pheromones; DAP Spray; Vocalizations; Dog Behavior

37

38 Introduction:

39 Each year large numbers of domestic dogs (*Canis familiaris*) are relinquished to animal rescue
40 shelters. In 2009 approximately 129,743 dogs entered UK welfare organisations (Clark et al.,
41 2012). Dogs enter shelters for many reasons, as strays or unwanted pets, or due to being
42 relinquished by their owners as a result of undesirable behavior (Fatjó et al., 2006). Many dogs
43 fail to find new homes and temporary kennel accommodation often becomes longer term
44 housing. Long term confinement in kennels can be stressful as a result of social isolation,
45 spatial restriction and changes in routine (Beerda et al., 1999). Over time, these factors can
46 contribute to chronic stress and subsequently compromised welfare in dogs (Beerda et al.,
47 1999).

48
49 Dog appeasing pheromones (DAP) are reported to be a chemical synthetic analogue of the
50 natural canine appeasing pheromone produced by a lactating bitch to reassure the puppy
51 (Pageat, 1999). According to the manufacturer, DAP promote calm behaviors in both young
52 and adult dogs (Adaptil, 2016). These products have been reported to calm dogs in stressful
53 environments such as kennels (Tod et al., 2005) and veterinary practices (Mills et al., 2006).
54 DAP can be administered using either a collar, spray or diffuser. The DAP collar or spray can
55 be used rapidly in areas where a plug-in diffuser is not practical, for example outdoor kennels
56 that lack a power supply to individual enclosures. As the spray is portable, it can be used in any
57 new areas where a dog may be fearful (Mills et al., 2006). In contrast, although a plug-in
58 diffuser allows for a continuous and longer lasting application of DAP in a larger environment
59 (Levine et al., 2007), it takes time to heat up and diffuse into the surrounding environment and
60 requires up to 24.00h to become fully effective (Adaptil, 2016). This means that any desired
61 effects of the product may not be observed in dogs that enter the environment until after a
62 delayed time period. Consequently, a spray formulation may be more useful in eliciting a more
63 rapid effect on problem behaviors.

64 While some studies have suggested that DAP may have some application in reducing anxiety
65 in dogs (e.g., Tod et al., 2005 and Mills et al., 2006), further investigation of the efficacy of
66 DAP in reducing canine stress is warranted. When used in combination with desensitization
67 and counterconditioning programmes, DAP administered using a diffuser has been reported to
68 reduce problem behaviors such as hyperactivity, excessive vocalizations and separation anxiety
69 in noise phobic dogs (Levine et al., 2007). It is worth noting that, because of study design,
70 effects due to the behavioral modification programme and the pheromone could not be
71 separated by Levine et al., (2007), so it's not possible to know which aspect of treatment
72 produced a reduction in fearful behavior (Frank et al., 2010). In these types of studies, a
73 reduction in fearful behavior cannot be solely or accurately attributed to DAP and any potential
74 effects of a behavioral modification programme need to be considered.

75
76 Previous research has suggested that DAP administered using a diffuser reduces stress and fear
77 related behaviors in dogs in both a shelter environment and veterinary practice (Tod et al.,
78 2005; Mills et al., 2006). Shelter dogs exposed to DAP emitted from a diffuser exhibit barking
79 of a lower decibel level and reduced frequency, which was purported to show reduced stress
80 levels (Tod et al., 2005). It is important to note though that while a reduction in barking
81 amplitude and frequency was reported in Tod et al., (2005), statistical methods were used
82 which caused results to not always be directly comparable among treatment groups (Frank et
83 al., 2010). Consequently, comparisons between any effect of DAP as opposed to the control
84 could not be reliably made. It has also been reported that initial exposure to DAP is effective in
85 reducing signs of anxiety but not overt aggression in dogs in the veterinary clinic environment
86 (Mills et al., 2006). However, methodological limitations, including an inadequate
87 randomization scheme and unclearly defined inclusion criteria, need to be considered when
88 interpreting the results of Mills et al., (2006). Neither study reported treatment outcome, so it is
89 also unclear how many participants failed to respond to the DAP treatment. True pheromones

90 are known to control behavior, but previous studies utilizing DAP, a synthetic analogue, have
91 methodological limitations which make it inherently difficult to determine any true
92 effectiveness (Frank et al., 2010).

93
94 Studies incorporating portable DAP (e.g., impregnated collars) have been used in canine travel-
95 related research and postulated to be effective, to some extent, by controlling sympathetic
96 arousal (e.g., Estelles and Mills, 2006). Previous study of the efficacy of DAP has tended to
97 focus upon administration via diffuser or collar and, to our knowledge, no previous studies
98 have examined the behavioral responses of dogs to DAP spray in a shelter setting. Spray
99 administration may be beneficial in rescue shelters because it allows immediate application of
100 product in areas, such as meet-and-greet rooms, where individual dogs may be viewed at short
101 notice by potential adopters. Spray application may also be useful beyond the shelter
102 environment if adopted dogs encounter short-term stressors, such as new introductions to
103 existing animals within the household. The aim of this study was to determine whether DAP
104 spray reduced vocalization intensity and frequency of stress related behaviors in dogs housed
105 in a rescue shelter upon exposure to a stressor.

106

107 **Materials and Methods**

108 *Subjects and Study Site*

109 Twenty five dogs, 16 males (14 neutered, 2 entire) and 9 females (8 spayed, 1 entire) aged
110 between 5 months and 168 months (mean age: 41.64 months) were used in this study (Table 1).
111 Thirteen of the dogs were purebred, with the remaining dogs being cross or mixed breeds.
112 Twelve of the dogs were strays and thirteen of the dogs were relinquished to the shelter. Dogs
113 were placed into either small $n = 2$ (< 10 kg), medium $n = 15$ (> 10 kg but below 25 kg) or
114 large $n = 8$ (> 25 kg) weight categories (Kim et al., 2011). All dogs were in good general health
115 and were housed at Worcestershire Animal Rescue Shelter, Worcestershire, UK. The study

116 took place using either 1.5 x 2.7 m kennels or 2.7 x 5.6 m kennels. Larger dogs and dogs who
117 the shelter deemed as displaying high levels of behavior indicative of stress were put in the
118 larger kennels and therefore kennel size was unable to be controlled within this study. Kennels
119 were situated in a row with a wire mesh fronted barrier. Dogs were housed individually and
120 each kennel contained a bed, blanket and water bowl. Dogs were fed at 08:15h and again at
121 14:00h. A walkway located 10 meters away from the outside of the kennels was used to
122 exercise the dogs on a daily basis (approximately twice a day), so the focal dogs in this study
123 were used to the presence of other dogs walking in front of the kennels. Data were collected
124 outside of normal walking times (10:00h – 16:00h) and public viewing times (11:00h – 15:00h)
125 to avoid the influence of other dogs and also human presence on the focal dogs' behavior.

126

127 *Procedure*

128 A repeated measures design was used to assess the behavioral responses of the dogs to
129 exposure to DAP spray. These behavioral measures were scored in the presence of a 'stressor' -
130 a neutral dog personally owned by the researcher who was unfamiliar to all dogs, who was led
131 past the kennels (approximately at a 1 m distance) during data collection to induce a behavioral
132 response so any effects of DAP could be measured. Dogs that were not participating in the
133 study were either shut inside the kennel block or in the isolation block, which was separated
134 away from the main kennels.

135

136 Dogs were allocated to an order of conditions depending on when they arrived at the shelter,
137 with longer resident dogs allocated first followed by new arrivals. The conditions were
138 counterbalanced (without DAP/with DAP, n = 12, with DAP/without DAP, n = 13) to control
139 for order effects. Dogs were divided in to ten smaller groups for ease of observation. Each
140 group of dogs experienced the control condition (without DAP spray) and the exposure
141 condition (with DAP) which occurred on consecutive days with observations repeated twice a

142 day at 09.00 h and 17.00 h. In the DAP condition, two pumps of the 60ml DAP spray were
143 applied to each of the four corners of the kennel 30 minutes prior to exposure to the stressor to
144 assess the effect of the spray on barking intensity, frequency of barking and other stress related
145 behaviors (Tod et al., 2005; Levine et al., 2007). The spray was applied when dogs were
146 removed from the kennel to allow the pheromone to dissipate into the environment and to
147 allow alcohol evaporation (Tod et al., 2005; Levine et al., 2007). There was no placebo
148 treatment in this study, and researchers were not blinded to treatment.

149
150 Dogs remained in the same kennel throughout the experiment. Observations were conducted 30
151 minutes after application of the product (as per Graham et al., 2005) with behavioral
152 observations starting with the appearance of the stressor dog at approximately 1 meter from the
153 kennel and each observation lasting 10 seconds. Focal sampling was used to record the
154 frequency of behaviors displayed by the dogs. Behaviors potentially associated with canine
155 stress, including low body posture, licking lips, yawning, panting and vocalizations (Beerda et
156 al., 1999; Tod et al., 2005) (Table 2), were recorded, as was the barking intensity. Mean
157 barking intensity (dB) was recorded during each 10 second observation using a decibel meter
158 (Max Measure, Universal Supplies Ltd), located 15 meters from the kennel block and
159 centralised to the kennels' centre using a marker. The frequency of occurrence of other stress
160 related behaviors were captured using video recorded behavioral observations (Go Pro Hero,
161 Foxconn). The Go Pro Hero was hand held by the researcher, while walking the stressor dog
162 past the focal dogs, and was set on 720p resolution, 60 frames per second and set in 'super
163 view' mode to capture multiple dogs' behaviors at the same time. Dogs in each group were
164 recorded at the same time to avoid repeated exposure to the stressor dog and therefore
165 minimise habituation or sensitisation. Video footage was analysed at a later date and video files
166 were renamed by the researcher prior to analysis to minimise observer bias.

167

168 *Statistical Analysis*

169 Decibel readings with and without the use of the DAP spray were recorded and summed to
170 provide a mean dB reading per condition per group. The frequency of dogs displaying the
171 behavior was summed providing an overall frequency count per dog per behavior. For auditory
172 analysis, paired t-tests were performed to test for differences in the decibel level of dogs
173 between the two conditions, with and without the DAP spray. Paired t-tests and Wilcoxon
174 signed-rank tests were used to test whether there was a statistically significant difference in
175 behavior with and without the use of pheromones. These tests were chosen according to
176 whether the assumptions underlying parametric analysis were sufficiently met. All data were
177 checked for normality using Kolmogorov-Smirnov tests. The significance level was set *a priori*
178 at $p = 0.05$ and all statistical analysis was performed using SPSS (version 22, 2013).

179

180 **Results**

181 Exposure to DAP spray in the presence of a stressor resulted in no significant differences in the
182 occurrence of stress related behaviors, however significant effects upon intensity of barking
183 were found.

184

185 *Barking Intensity*

186 There was a significant difference in barking intensity when dogs were exposed to DAP spray
187 ($t = 4.329$, $df = 9$, $P = 0.002$). The mean barking intensity was lower in the DAP spray
188 condition as opposed to when dogs were not exposed to DAP (Table 3: DAP spray = 57.16 dB,
189 no DAP spray = 63.64 dB).

190

191

192 *Non-Significant Behavior*

193 There were no significant differences in frequency of barking ($t = 0.000$, $df = 24$, $P=1.000$),
194 paws on the fence ($t = -1.633$, $n = 25$, $P= 0.102$), low posture ($t = -0.816$, $n = 25$, $P= 0.414$) and
195 lying down ($t = -1.667$, $n = 25$, $P= 0.096$) (Table 3). Where behaviors were exhibited at very
196 low levels (mean occurrence < 1) they were omitted from analysis as statistical analyses are not
197 robust at such low levels.

198

199 **Discussion**

200 The present study is the first, to our knowledge, to test the efficacy of DAP spray in reducing
201 vocalization intensity and frequency of stress related behaviors in shelter dogs. No significant
202 differences in stress related behaviors or barking frequency were found in this study, although
203 small differences in mean barking intensity in the presence of a stressor were found in dogs
204 that were exposed to DAP spray. Barking intensity was lower in the condition where dogs were
205 exposed to DAP spray. It is difficult to conclude that the small reduction of 6.48dB in loudness
206 in the DAP condition is clinically or biologically significant or beneficial for the dogs'
207 welfare. Our results should be interpreted with caution when attempting to draw conclusions
208 regarding DAP and shelter dog welfare.

209

210 Alternative explanations need to be considered. Rescue shelters can be a stressful environment
211 for dogs due to psychological and physiological stressors (e.g., noise and both spatial and
212 social restrictions) (Hubrecht, 1995; Tuber et al., 1999; Taylor and Mills, 2007). It is possible
213 that the level of stress experienced in the shelter environment in this study, whether due to the
214 stimulus of the stressor dog, or due to the kennel environment itself, may have been too great
215 for DAP to have a marked effect on the dogs' behavior, if pheromonal analogue products
216 produce only mild effects. Both social isolation and the inability to control the environment
217 and behavioral opportunities have been suggested as stressful to dogs (Hubrecht, 1995; Tuber
218 et al., 1999; Taylor and Mills, 2007). It is possible that the presence of the stressor dog

219 walking past the kennels and the kennelled dogs not having the opportunity to interact with the
220 individual or having the ability to control the interaction may have resulted in sufficiently high
221 stress levels, that such products are not adequate redress. Similarly, the shelter environment
222 may have been too stressful for such products to have a noticeable effect on the dogs' behavior.
223 Further controlled, blinded studies considering the use of DAP in response to different stressors
224 and in different situations would be useful to determine whether use of the product is warranted
225 at all, or only indicated in restricted contexts.

226

227 In both conditions in our study, behavioral responses such as barking frequency, paws on fence,
228 low posture and lying down remained unchanged. Future studies of DAP could combine
229 behavioral indicators with non-invasive sampling of saliva to see whether there are any
230 physiological changes relating to distress exhibited in rescue shelters, which are deemed as
231 stressful environments for dogs (Hubrecht, 1995; Tuber et al., 1999; Taylor and Mills, 2007).

232

233 Behavioral responses have been found to vary substantially between individuals in a rescue
234 shelter environment (Steven and Ledger, 2005) due to temperament (Jones and Gosling, 2005)
235 and coping style (Steven and Ledger, 2005), which can be attributed to genetic factors such as
236 breed and sex (Serpell and Hsu, 2005) and to environmental factors such as experience
237 (Appleby et al., 2002), rearing environment (Harvey et al., 2016) and neuter status (Serpell and
238 Hsu, 2005). Previous studies have reported large individual variations in behavior of kennelled
239 dogs (Hubrecht, 1995 and Titulaer et al., 2013). The small sample size used in our study may
240 have meant that behavioral variation was limited in the dogs observed. If the effects of
241 pheromonal analog products are restricted to a range of behavioral presentations, these may not
242 have been represented in a small sample size study.

243

244 Because of the lack of effect of DAP on the stress indicators assessed in this study, such
245 treatment does not enhance welfare under these study conditions. However, novel, stimulating
246 and unpredictable environments like shelters may facilitate barking (Tod et al., 2005). High
247 noise levels caused by vocalisations can implicate welfare through potentially damaging dogs'
248 hearing in shelter situations in a relatively short period of time (Scheifele et al., 2012). It is
249 possible that some dogs in this study may have had altered hearing, given their exposure to
250 barking dogs housed in the shelter, and that this potential outcome, which occurs with time,
251 may have changed behavior. Kennelled dogs are regularly exposed to sound levels over 100dB
252 and it has been reported that noise levels in excess of 100dB can damage dogs' hearing
253 (Scheifele et al., 2012). Since only a low dB range (51-73 dB) was recorded in both conditions
254 in the present study, welfare was unlikely to have been impacted through hearing loss. The
255 effect size in this study was small, with only a 10.1% decrease in noise intensity found in the
256 DAP condition. Such a small decrease of 6.48dB, which was still within the low dB range
257 reported, is unlikely to have improved welfare by reducing the risk of hearing loss in this study.
258 The low range of dB readings recorded may have been attributed to the location of the decibel
259 meter, which was located 15 meters from the kennel block and may have been located too far
260 away to record dB readings accurately. Future research could consider placing microphones
261 centrally within the kennel and suspended from the ceiling so they are closer and within the
262 hearing zone of the individuals (Scheifele et al., 2012).

263
264 As kennels are widely known to be noisy environments (e.g. Sales et al., 1997; Coppola et al.,
265 2012; Scheifele et al., 2012) with noise levels regularly exceeding 100dB and often reaching
266 125dB (Sales et al., 1997), it may be more prudent for shelters to implement noise abatement
267 measures instead of DAP and improve welfare through minimising the risk of hearing loss.
268 Such measures could include absorptive surfaces to decrease reverberation and increased levels
269 of sound insulation in kennels which may help reduce high sound levels (Sales et al., 1997). We

270 studied the dogs only when no visitors were present and when no other manipulations (e.g.,
271 feeding) were ongoing. If a decrement in barking was shown to occur in a controlled study in
272 the presence of DAP when others were present and/or more active manipulations occur, then
273 pheromonal analogues may have application in rescue shelters if a reduction in barking is
274 perceived as desirable by adopters.

275
276 There are a number of limitations to this study, such as the sample size, the use of only one
277 type of stressor and lack of control for breed, age or residency duration effects upon barking
278 intensity. Residency duration was confounded with order effects which may have impacted
279 how longer resident dogs reacted to the stressor dog. There was also an assumption that the
280 stressor dog acted the same way during each exposure, however the stressor dogs behavior was
281 not measured. Measuring sound intensity in a kennel environment is also difficult due to
282 sources of noise from other dogs and equipment therefore background noise and socially
283 facilitated barking may have also confounded measurements of barking intensity. While these
284 confounding variables are difficult to control, they should be considered when interpreting the
285 results of this study. Additionally, location of dogs in kennels and weight versus kennel size
286 were not able to be controlled and may have affected level of exposure. It is also possible that
287 more rarely exhibited behaviors were missed due to the short recording period used in this
288 study (Martin and Bateson, 2007). This study was neither blinded, nor had a placebo control,
289 which would have allowed us to evaluate any effect of actually doing the study on outcome.
290 Future research on any potential effects of pheromonal analogue products on shelter dogs
291 should redress these limitations.

292

293 **Conclusions**

294 In summary, application of DAP spray was associated with a small reduction in barking
295 intensity in shelter dogs upon exposure to a stressor in this open label, non-placebo controlled

296 study. Our results should be interpreted with caution as a small reduction in dB level does not
297 mean the results are clinically or behaviorally significant. Other behavioral indicators of stress
298 were not observed to decrease in a statistically significant manner in a way that paralleled the
299 reduction in bark volume. Dogs bark for a variety of reasons, and it's beyond the scope of this
300 study to assign attribution for the barking, given the experimental design.

301

302 Conflict of interest statement

303 The authors have no conflict of interests to declare. None of the authors of this paper
304 have a financial or personal relationship with other people or organisations that could
305 inappropriately influence or bias the content of the paper.

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309 establishment and dogs to be used in this research. The authors would also like to thank the
310 anonymous reviewers for their helpful comments on the manuscript.

312 Ethical considerations

313 Approval for the study was not needed under the Animals Scientific Procedures Act 1986 or
314 the European Union Directive 2010/63/European Union. The study abided by the guidelines of
315 the Institutional Research Ethics Committee.

317 Authorship

318 The idea for the article was conceived by Christopher Hermiston and Sienna Taylor. The
319 experiments were designed by Christopher Hermiston and Sienna Taylor. The experiments
320 were performed by Christopher Hermiston. The data were analyzed by Christopher Hermiston.
321 The article was written by all the authors.

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- 382

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383 **Table 2**

384 Ethogram providing definition of behaviors sampled in the DAP spray study (adapted from
 385 Beerda et al., 1999 and Tod et al., 2005).

| Behavior | Definition |
|----------------------------------|--|
| Body posture and motor activity: | |
| Lying | Ventral/lateral lying on ground with all four legs resting and in contact with ground. Eyes may be open or closed. |
| Sitting | Hind quarters on ground with front two legs being used for support. |
| Paws on fence | Standing on two hind limbs supporting body other front legs against the fence. |
| Walking | Forward movement with legs resulting in shift of whole body to a new position in enclosure. |
| *Low posture | Head lower than shoulders, tail low, ears lowered. |
| Spinning | Rotating the body 360 degrees around. |
| Jumping | No limbs on the floor. |
| Vocalizations: | |
| *Bark | 'Rough' sound often repeated in quick succession. |
| *Growl | Deep threatening rumble. |
| *Yelp | Sustained high pitched sound related to howling/barking. |
| Displacement: | |
| *Yawn | Mouth opens wide for a period of a few seconds, then closes. |
| *Lick Lips | Tongue extends upwards to cover lips, before retracting into mouth. |
| *Pant | Mouth opens with tongue extended accompanied with rapid breathing and expansion/contraction of chest. |

Escape Behavior:

| | |
|-------------|--|
| Exit rear | Standing on hind legs with front legs resting against exit |
| Wall bounce | Standing on hind legs with front legs rebounding off wall—usually repetitive |
| Bar pawing | Using paws to reach through mesh exit—in a digging motion |
| Exit stare | Dog's gaze focused on exit points. |

Exploratory Behavior:

| | |
|-----------------|--|
| Sniff | Air inhaled forcibly through nose. |
| Lick object | Tongue extends to touch object before retracting into mouth. |
| Nose/paw object | Use of paw/nose to manipulate object. |

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387 *Indicates stress related behaviors

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Appended Table

Table 1: Demographics of population sample

| Breed Composition | Dog ID Number | Sex | Status | Approximate Age (Months) | Length of Residency in Shelter (Rounded up to nearest week) |
|----------------------------|----------------------|------------|---------------|---------------------------------|--|
| Labrador | F1 | F | Neutered | 85 | 3 weeks |
| English pitbull terrier | F2 | F | Neutered | 48 | 3 weeks |
| Chihuahua/Jack Russell | F3 | F | Neutered | 12 | 2 weeks |
| Collie | M1 | M | Entire | 5 | 3 weeks |
| Great Dane | M2 | M | Neutered | 12 | 4 weeks |
| Saluki, lurcher cross | M3 | M | Entire | 20 | 12 weeks |
| Great Dane | M4 | M | Neutered | 12 | 4 weeks |
| Lurcher | F4 | F | Neutered | 19 | 18 weeks |
| Labradoodle | F5 | F | Neutered | 30 | 9 weeks |
| Husky, collie cross | F6 | F | Neutered | 26 | 16 weeks |
| Trailhound | F7 | F | Entire | 88 | 12 weeks |
| Lurcher | M5 | M | Neutered | 53 | 5 weeks |
| Springer apaniel | M6 | M | Neutered | 40 | 1 week |
| Deerhound | M7 | M | Neutered | 11 | 1 week |
| Staffordshire bull terrier | M8 | M | Neutered | 16 | 1 week |
| Collie | M9 | M | Neutered | 168 | 1 week |
| Husky | M10 | M | Neutered | 18 | 1 week |
| Akita | M11 | M | Neutered | 38 | 1 week |
| Labrador | M12 | M | Neutered | 41 | 1 week |
| Lurcher | F8 | F | Neutered | 11 | 1 week |
| Trailhound | M13 | M | Neutered | 53 | 2 weeks |
| Trailhound | F9 | F | Neutered | 53 | 2 weeks |
| Lurcher | M14 | M | Neutered | 129 | 2 weeks |
| Collie | M15 | M | Neutered | 26 | 2 weeks |
| Staffordshire bull terrier | M16 | M | Neutered | 27 | 2 weeks |

Table 3: Summary of raw behavior and decibel data

| Behavior Data | | | | | | | | | *Decibel Data (dB) | | | | | | |
|---------------|----------------------|----------------------------|--------------------|--------------------------|----------------------|----------------------------|--------------------|--------------------------|-----------------------|-----------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Dog ID | Frequency of Barking | N = 12 Without DAP | | | N = 12 With DAP | | | Group Number | N = 12 Without DAP | | | N = 12 With DAP | | | |
| | | Frequency of Paws on Fence | Frequency of Lying | Frequency of Low Posture | Frequency of Barking | Frequency of Paws on Fence | Frequency of Lying | | dB Reading AM | dB Reading PM | dB Reading Average | dB Reading AM | dB Reading PM | dB Reading Average | |
| F1 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | Group 1 | 60.66 | 60.15 | 60.41 | 57.96 | 53.23 | 55.60 |
| F2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | | | | | | | |
| F3 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | | | | | | | |
| M1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | Group 2 | 66.01 | 67.91 | 66.96 | 50.65 | 60.26 | 55.46 |
| M2 | 2 | 1 | 0 | 0 | 2 | 1 | 0 | 0 | | | | | | | |
| M3 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | | | | | | |
| M4 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | Group 3 | 69.39 | 62.51 | 65.95 | 63.69 | 60.21 | 61.95 |
| F4 | 2 | 3 | 0 | 0 | 0 | 2 | 0 | 0 | | | | | | | |
| F5 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | Group 4 | 62.14 | 68.05 | 65.10 | 52.20 | 49.30 | 50.75 |
| F6 | 6 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | | | | | | | |
| F7 | 0 | 1 | 1 | 0 | 0 | 0 | 3 | 0 | Group 5 | 61.82 | 69.38 | 65.60 | 60.69 | 61.42 | 61.06 |
| M5 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 0 | | | | | | | |
| | | **N = 13 Without DAP | | | **N = 13 With DAP | | | | | N = 13 Without DAP | | | N = 13 With DAP | | |
| Dog ID | Frequency of Barking | Frequency of Paws on Fence | Frequency of Lying | Frequency of Low Posture | Frequency of Barking | Frequency of Paws on Fence | Frequency of Lying | Frequency of Low Posture | Group Number | dB Reading AM | dB Reading PM | dB Reading Average | dB Reading AM | dB Reading PM | dB Reading Average |
| M6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Group 6 | 70.41 | 69.40 | 69.91 | 71.53 | 74.13 | 72.83 |
| M7 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | | | | | | | |
| M8 | 2 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | | | | | | | |
| M9 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | Group 7 | 53.82 | 60.53 | 57.18 | 64.38 | 71.99 | 68.19 |
| M10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | |
| M11 | 7 | 2 | 0 | 0 | 7 | 2 | 0 | 0 | | | | | | | |
| M12 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | Group 8 | 53.46 | 54.49 | 53.98 | 60.37 | 63.08 | 61.72 |
| F8 | 6 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | | | | | | | |
| M13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | | | | | | |
| F9 | 0 | 0 | 2 | 0 | 0 | 0 | 3 | 0 | Group 9 | 52.22 | 52.72 | 52.47 | 49.59 | 51.97 | 50.78 |
| M14 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | | | | | | |
| M15 | 2 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | Group 10 | 47.64 | 58.91 | 53.28 | 58.89 | 58.91 | 58.90 |
| M16 | 2 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | | | | | | | |

*dB readings were recorded in both the morning (AM) and afternoon (PM) and were recorded as an average reading per trial/per condition. ** Note: The conditions were counterbalanced (without DAP/with DAP, n = 12, with DAP/without DAP, n = 13).