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Efficacy of dog appeasing pheromone in reducing stress and fear related behaviour in shelter dogs

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Abstract

The behavioural effects of dog appeasing pheromone (DAP) continuously administered over a 7-day period, were evaluated in adult dogs housed in a public animal shelter. Barking amplitude (dB) and the frequency of discrete behavioural responses to two temperament tests associated with fear, separation and excitable behaviour (Arrowsmith, unpublished data) were recorded in 37 treatment and 17 control dogs. Mean barking amplitude (L_{eq}) and barking frequency were significantly reduced in dogs subject to DAP exposure for 7 days ($P < 0.001$, <0.04, respectively), though peak values (L_{peak}) were not significantly altered. There was also some reduction in the barking amplitude of dogs during the 1 min recovery period, following a distraction. Following 7 days of DAP exposure, there were significant differences in resting ($P = 0.03$), barking ($P < 0.04$) and sniffing frequency ($P = 0.01$) in response to a friendly stranger. There were no highly significant differences in response to a neutral stranger. The preliminary tests indicate that DAP is a useful palliative tool for reducing some behavioural indicators of stress in dogs. Further tests are necessary to investigate the use of DAP in canine stress reduction in conjunction with traditional behavioural therapy programmes.

Keywords: Dogs; Stress; Pheromones; Behaviour; Separation; Kennels

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1. Introduction

Veterinary surgeons in the United Kingdom reported that many of the behavioural cases presented to them in 2002 were separation or fear related. Many of the problem behaviours experienced by dog owners and kennel workers are due to this phenomenon (APBC, 2003). Behaviours such as excessive vocalisation, destructiveness, inappropriate elimination and excessive licking are widely thought to be coping mechanisms for the dog when separated from the owner, and are key diagnostic criteria in the identification of a dog suffering from fear or separation related problems (CEVA Santé Animale; Sheppard and Mills, 2003).

It is common for such symptoms to be managed through a programme of behavioural therapy. However, this approach requires commitment and regularity in the household routine, and often a deliberate weakening of the owner—pet bond in the case of separation related problems. This can sometimes prove challenging for the owner who has difficulty in reducing contact with the dog, and also in homes with multiple occupants where it is difficult to enforce changes in routine (Mugford, 1995; Podberscek and Serpell, 1999). In circumstances where dogs do not respond to behavioural therapy, pharmacological agents can be prescribed to manage the dog's behavioural symptoms e.g. Amitryptiline, and Clomipramine (King, 2000). Such treatments can have sedative effects due to their cerebral suppressant properties (Sari et al., 1975, King, 2000).

The field of mammalian pheromone research established itself primarily in response to a study on boar pheromones which were shown to induce immobility in the sow during oestrus (Watson and Radford, 1960). This landmark study demonstrated the potential benefits of producing synthetic analogues of pheromones (Pearce et al., 1988, Pageat and Gaultier, 2003). Pageat (1999), who discovered the production of DAP in lactating dams, was the first to artificially synthesise this pheromone in dogs, opening up the possibility of using appeasing pheromones in a clinical capacity to tackle fear and separation problems in dogs. A similar product called ''Feliway'', developed for cats and based on feline facial pheromone secretions, has also been received with interest by the scientific and veterinary community.

The natural form of DAP is produced 3 days following parturition by the lactating dam (Pageat and Gaultier, 2003). The pheromone vaporises when combined with saprophytic bacteria present in the skin. This bacteria is important in increasing the volatility of the pheromone, which is then released from the intermammary sulcus directly into the atmosphere as an air-borne molecule (Pageat and Gaultier, 2003). DAP is then absorbed by the puppies through a paired olfactory structure, present in the nasal cavity, called the vomeronasal organ (VNO). It is this structure which transduces the pheromonal signal to the amygdala and hypothalamus (Pageat and Gaultier, 2003). The neurological pathways involved in the transduction of this appeasing signal are not completely understood, however recent research has highlighted the importance of pheromone binding proteins, (PBPs) present in the nasal mucus, as being important in the uptake of DAP (Pageat and Gaultier, 2003). Synthetic DAP is administered into the air through an electrically heated diffuser, and is understood to work equally well on puppy and adult dogs alike, although definitive research has not been conducted to date, on this question (CEVA Santé Animale).

As it is not a cerebral supressant, it does not have the side effects described above for some pharmacological agents and has been proposed as a 'natural' way to reduce fear and stress related behaviours in dogs. Recent research by Sheppard and Mills (2003) has demonstrated that DAP has the potential to be of use in situations which owners commonly report as acute stress factors for dogs, in particular the use of fireworks. No controlled trials investigating the efficacy of DAP to calm dogs exposed to potentially stressful situations have however been published to date.

Dogs with behavioural problems are frequently given up to shelters as a last resort when the owner can no longer cope (Voith and Borchelt, 1996; Voith and Ganster, 1993). On being relinquished to an animal shelter, the dog's behaviour can often worsen, reducing further the chance of being successfully re-homed. Dog shelters are widely reported to exacerbate, problem behaviour in dogs (Hennessy et al., 2001; Sales et al., 1997; Hennessy et al., 1998). Even in well run shelters, the intrinsic problems of noise, novelty, change in routine, lack of visual contact with other dogs and an unpredictable environment; are all considered to be psychological stressors which can result in fear and stress related behaviours as described above (Hanson et al., 1976; Hennessy et al., 1998).

The aim of this study was to investigate the efficacy of DAP as a potential stress reducing aid by measuring vocalisations of dogs and recording the behaviour of shelter dogs in response to scientifically validated behavioural tests (Arrowsmith, unpublished data) in the absence and presence of DAP. A Scottish SPCA animal shelter was chosen as the venue for this study.

2. Materials and methods

2.1. Animals

This study was undertaken at a Scottish SPCA Animal Welfare Centre in Dumbarton, Scotland. Three separate kennel blocks, similar in design and layout, provided control of pheromonal distribution through separation of blocks via doors and corridors. The study animals were housed individually in wire mesh fronted holding pens, and were allowed day time access to an attached outdoor kennel run via a small door in their indoor pen, except during a short period of time for kennel cleaning. Each kennel measured 1.6 m $\times$ 1.0 m ($l \times w$) for the indoor section, and 3.9 m $\times$ 1 m ($l \times w$) for the run. A total of 37 treatment dogs and 17 placebo/control dogs of random age, gender, breed and life history were tested in this study, the only discrimination being that no dogs were undergoing behaviour therapy or psychopharmacological intervention, also that young puppies under 6 months of age should not be used.

2.2. Experimental tests

The study was blind, randomised and placebo controlled as the test administrator was not aware at time of testing which dogs were in the control group. All dogs were tested individually. The DAP electrical diffusers were labelled A–C and an assistant kept a record of which letter constituted the control diffuser, which had a rinsed, empty pheromone bottle attached to it. All pheromone bottles were covered to ensure the placebo diffuser could not be visually identified by the tester. All behavioural tests conducted were adapted from a set of scientifically validated temperament tests suitable for measuring discrete behavioural traits associated with fearfulness and separation anxiety (Arrowsmith, unpublished data) and were performed without direct physical contact with the dogs. For all dogs, control and experimental, baseline data was recorded at day 0 before the DAP diffusers were plugged into the electrical sockets and data for comparison was then recorded on the same dogs following 7 days of exposure to the pheromone. The electrical diffusers were placed above the internal pens and each kennel block had one DAP diffuser which covered an area of up to 70 m^2 which was deemed more than adequate for the internal dimensions of each kennel block (CEVA Santé Animale). A 1-week trial was conducted before the study commenced to ensure all tests and recording procedures were adequate. During the actual study, testing was employed over a period of 10 weeks, in order to gain enough dogs for this study, please see table one for details. A wash out period of 7 days was employed between each batch of testing to ensure that any remaining pheromone circulating in the air of each kennel block was given ample time to dissipate from the environment before baseline data was recorded for the next batch of dogs, given that DAP is a chemical with low-volatility and therefore a low rate of dissipation. Each individual dog was given a code number to aid identification on return to the kennel for the follow up data collection at 7 days. Details such as breed, age, sex and colour were also recorded. Each dog was only tested once during this study.

2.3. Barking amplitude in response to a distraction

All measurements of sound pressure level (amplitude) were made in dB, using an A-weighting scale to cover sound in the 0.5–10 kHz frequency range (low frequency), because most of the energy in a dog's bark, as well as the dog's auditory sensitivity is centered in this frequency range (Peterson, 1980; Sales et al., 1997). The maximum barking amplitude in each block was recorded (L_{peak}), as was the average amplitude over the one minute recording session (L_{eq}). All recordings were made using a Realistic 33-2050 © sound meter with a range of up to 126 dB (Table 1).

The average barking amplitude for each kennel block, collectively, was recorded at the start of each session and with the observer out of the dogs view. The observer then walked up and down the kennel block at a steady pace, avoiding eye contact with the dogs, in order to act as a distraction. The barking amplitude was then recorded every 5 s. The observer,

Table 1
Number of placebo and treatment group dogs per week of data collection

Week no.	No. of dogs	
	Placebo	Treatment
1	3	6
2	4	2
3	2	7
4	5	13
5	3	9
Total	17	37

again, then moved out of visual contact with the dogs and recorded barking amplitude for a further 60 s as an index of recovery time. It is important to note that all three kennel blocks were constructed of the same materials, which helped to standardise the acoustic levels, therefore maintaining uniformity for barking amplitude recording between kennel blocks.

2.4. Behaviour tests

A behavioural ethogram (see Table 2) was used to record the frequency of discrete behavioural categories correlated with a high intensity fear response (Sheppard and Mills, 2003; Shull-Selcer and Stagg, 1991; Thompson, 1998) and behaviours indicating less intense fear but still constitute a welfare issue for these dogs (Sheppard and Mills, 2003).

Table 2
Behavioural ethogram

Body postures 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
Standing	All four paws on ground and legs upright and extended supporting body
Walking	Forward movement with legs resulting in shift of whole body to a new position in enclosure
Posture low	Head lower than shoulders, tail low, ears lowered
Vocalisations	
Bark	'Rough' sound often repeated in quick succession
Growl	Deep threatening rumble
Whine	Sustained whimper
Displacement activities	
Yawn	Mouth open wide for a period of a few seconds, then closes
Lick nose	Tongue extends upwards to cover nose, before retracting into mouth
Pant	Mouth open with tongue extended accompanied with rapid breathing and expansion/contraction of chest
Escape behaviour	
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 behaviours	
Sniff	Air inhaled forcibly through nose
Lick other/object	Tongue extends to touch object before retracting into mouth
Nose/paw object	Use of paw/nose to manipulate box (distraction test)
Attention seeking/excitability	
Polydipsia	Self-explanatory
Trembling	All or part of body shaking
Nosing	Intentional pressing of nose against observer
Pawing	Intentional pawing observer
Urination/defaecation	Self-explanatory

Ethogram of discrete behavioural categories indicative of fear, separation anxiety and general excitability.

The following tests were administered randomly to the dogs to reduce the chance of an order effect.

Focal sampling and continuous recording over one minute were used for the neutral stranger and friendly stranger test described below.

2.5. Neutral stranger test

The observer stood next to the wire mesh door of each kennel and adopted a sideways stance, at a 90° angle to the dog. Eye contact was not made with the dog and any attempts by the dog to attract the observer's attention were ignored. For 1 min, the observer recorded the dog's behaviour on a check sheet, using a behavioural ethogram of behaviours indicative of stressful/fearful behaviour (Flannigan and Dodman, 2001; Lund and Jorgenson, 1999), see Table 2. This test was adapted from the stranger test for aggression reviewed by Arrowsmith (unpublished date).

2.6. Friendly stranger test

As above, except the observer (same person as before) adopted a kneeling position, face to face with the dog with arm extended and palm facing upwards. As above, each dog's behaviour was recorded on a check sheet using the same behavioural ethogram.

2.7. Statistical analysis

All data was analysed using the statistical package Minitab, version 13. Parametric two sample *t*-tests and paired *t*-tests were used to analyse the barking amplitude data and non-parametric Mann–Whitney *U* and Wilcoxon sign-rank tests were used for the behavioural data collected during the neutral and friendly stranger tests (Petrie and Watson, 1999).

3. Results

Table 3 indicates the breed distribution and Table 4 the sex distribution for both the DAP treatment and placebo control groups for the dogs which were present at the kennel for both baseline testing at day 0 and final testing at day 7. Table 3 details a disproportionate number of Mongrels, Border Collies/Collie Crosses and German Shepherd dogs in this study within and between the placebo and treatment groups; however, this is in line with the most common breeds referred to vets for behavioural problems in 2002 (APBC, 2003). None of the 37 treatment dogs and 17 placebo dogs were taking any form of anxiety reducing medication, which may cause drowsiness or other alterations in normal behaviour. Dogs on such medication were housed separately in an isolation kennel block.

The demographic data in Table 4 reports that the presence of dogs in the kennel was greater than bitches in both groups. This reflects the fact that during testing, dogs generally out numbered bitches in the animal shelter, although this was shown to be statistically insignificant, $P = 0.181$. Segovia and Guillamon (1993), reported that the VNO is sexually

Table 3
Demographic data, detailing the distribution of breeds in the treatment and placebo groups

Breed	Treatment group N (%)		Placebo group N (%)	
Mongrel	13	35	9	52.9
Pointer	1	2.7	0	0
GSD type	5	13.6	5	29.4
Terrier type	1	2.7	0	0
Labrador type	3	8.1	1	5.9
Staffordshire bull	1	2.7	1	5.9
Dalmation type	0	0	1	5.9
Jack Russell	1	2.7	0	0
Collie cross	8	21.6	0	0
Border Collie type	4	10.9	0	0
Total	37	100	17	100

Table 4
Demographic data detailing the sex distribution of dogs in treatment and placebo groups

Sex distribution	Treatment group N (%)		Placebo group N (%)	
Male	22	60	12	70
Female	15	40	5	30

dimorphic in mammals therefore the following behavioural test data (excluding barking amplitude measurements) were therefore, also analysed by sex to investigate any sex differences in the dog's responses to DAP. However, no significant differences were found. The efficacy of DAP through varying age groups could not be investigated due to the unavailability of accurate data for some dogs. However, no dogs suspected of being under 6 months of age were included in this study. Puppies were also housed separately from adult dogs.

3.1. Barking amplitude in response to a distraction

3.1.1. Walking test data

The following data was recorded during a 1 min session where the test observer walked steadily along the staff passageway of the internal section of the kennel. No significant difference was found for barking amplitude between the placebo baseline data for day 0 and the placebo final data for day 7 $P > 0.05$. This test acted as a control to ensure external variables such as ambient noise or road traffic could not cause a significant increase in barking amplitude which could then subsequently be attributed to DAP.

Fig. 1 illustrates a clear and significant difference in the mean sound pressure levels (L_{eq}) between the placebo control group and the DAP treatment group at 7 days, over the course of the 1 min recording session. The mean barking amplitude was significantly reduced in the treatment group exposed to DAP, $T = 5.73$, $P < 0.001$. The data showed a peak in mean barking amplitude approximately half way through testing (30 s) at approximately 94 dB in the placebo group and 81 dB in the treatment group. However, on

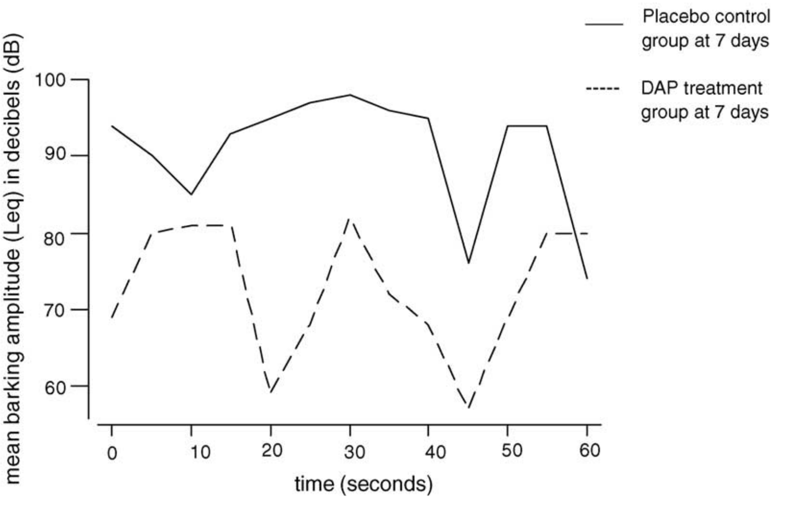

Fig. 1. Mean barking amplitude (L_{eq}) for placebo control and DAP treatment groups at 7 days, across a 1 min recording period.

average, there was a difference of 20 dB at any one time between the placebo and DAP treatment groups.

Interestingly, there was no significant difference in peak barking amplitude (L_{peak}) of the placebo and DAP treatment groups at day 7, indicating that the dogs still barked as loudly in response to the walking test in the presence or absence of DAP. As before, no significant differences in barking amplitude were found for the L_{peak} values, between 0 (baseline) and 7 days (final) following DAP exposure.

3.1.2. Recovery data

There was a significant reduction in the mean barking amplitude recorded over a 1 min recovery period following 7 days exposure to DAP, in comparison to the placebo control data at 7 days, as shown in Fig. 2, $T = -3.42$, $P = 0.002$. This suggests that DAP helps dogs to recover from a distraction more quickly by reducing mean barking amplitude after 60 s to 42 dB in the presence of DAP, in comparison to 68 dB in the placebo group. This should be interpreted with caution however, as the recovery data for the DAP treatment group at day 0 baseline and day 7 final testing was not significant, $T = -1.92$, $P = 0.07$.

3.2. Behavioural tests

For the following tests, defecation, urination and polydipsia were excluded from analysis due the absence or rarity of their occurrence during testing.

3.2.1. Neutral stranger test

The following findings were recorded in response to a neutral passive stranger standing outside the entrance to the indoor kennel enclosure (see Section 2). There was no

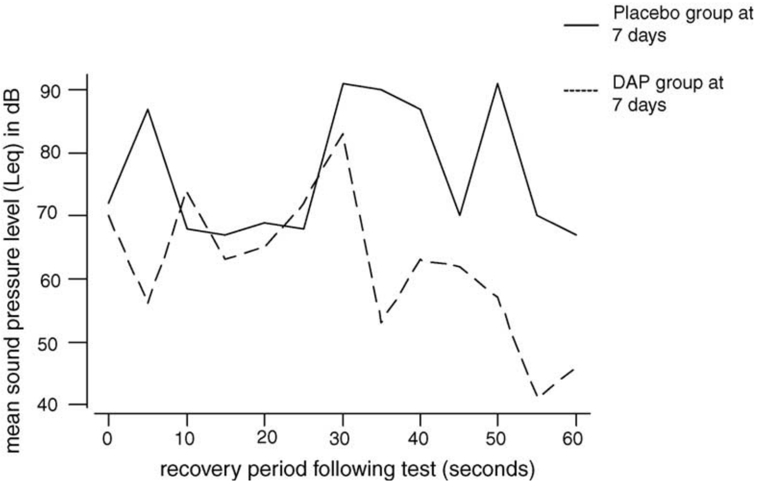

Fig. 2. Mean sound pressure level (L_{eq}) over a one minute recovery period, for the placebo group at day 7 and the DAP treatment group at day 7, measured in dB.

significant difference in the frequency of movements and postural transitions during this test at day 0 and day 7 following continuous exposure to DAP.

The frequency of sniffing behaviour was not significantly increased after 7 days exposure to DAP, although there was a trend in this direction. There was no significant difference in body postures or movement activity between days 0 and 7.

No significant differences were found for growling or whining, displacement activities or any form of escape behaviours recorded as per the behavioural ethogram, $P > 0.10$.

Fig. 3. Sniffing frequency in dogs at day 0 before exposure to DAP, and at 7 days, following continuous exposure to DAP, $n = 37$ (in response to friendly stranger test).

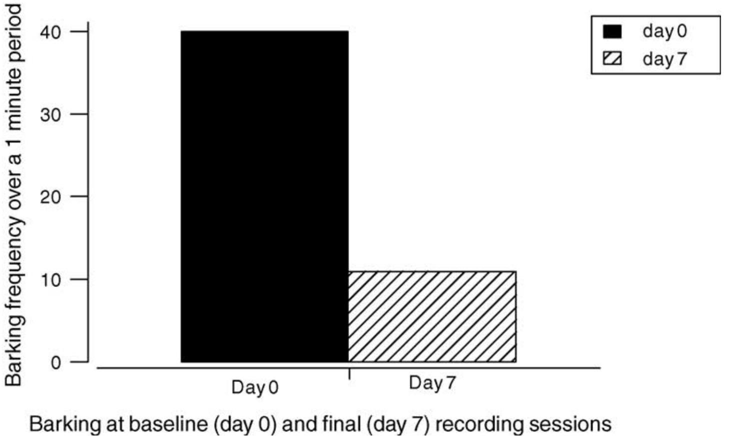

Fig. 4. Barking frequency in dogs at day 0 before exposure to DAP, and at day 7, following continuous exposure to DAP, $n = 37$ (in response to friendly stranger test).

3.2.2. Friendly stranger test

During the friendly stranger test, there was a significant increase in the frequency of sniffing behaviour in the DAP treatment group at day 7, $W = 62.5$, $P = 0.01$ (Fig. 3). There was also an increase in the frequency of dogs resting after continuous exposure to DAP for 7 days $W = 30$, $P = 0.03$. The evidence suggests that the quantities of DAP in the atmosphere were sufficient to induce opening of the VNO. In the presence of a friendly stranger, barking frequency was also significantly reduced following 7 days of continuous exposure to DAP as shown in Fig. 4, $W = 66.0$, $P < 0.04$.

4. Discussion

The results from this study suggest that DAP is potentially a useful palliative tool for reducing the severity and occurrence of some behaviours commonly associated with canine stress and anxiety. Sound pressure level recordings demonstrated a reduction in barking amplitude in response to DAP however, the meaning of this is arguably open to interpretation. Barking is known to be a dog's reaction to fear and anxiety, but also excitement, attention seeking and aggression, as well as being a known stressor itself (Sheppard and Mills, 2003; Sales et al., 1997). It is difficult to disentangle these elements to extract the true motivation underlying barking behaviour in the context of this study. Given, however, that factors such as a novel and unpredictable environment, social isolation from dogs and humans, and restricted space, are all inherent factors in any single housing dog kennel, it is reasonable to postulate that barking in this context may stem from fear, separation anxiety and the need for attention (Hennessy et al., 1998). Indeed, such behaviour problems are widely believed to be an integral problem in kennel dogs (Wells and Hepper, 1998).

Despite the inability to understand the precise motivation underlying barking behaviour in this study, it is still possible to identify a state of psychological stimulation and thus stress (be it positive or negative) as a common feature in all of the possible motivational causes described above. As such, it is perhaps more accurate to state that there is significant evidence to suggest that DAP reduces barking amplitude and therefore the dog's heightened state of excitement in response to a stranger walking by the kennel. This would be relevant when potential owners walk by the kennels to view the dogs, causing facilitative barking as a result of such stimulation.

A similar reduction in barking amplitude over a 1 min recovery period is consistent with the reduction during the kennel walk test, and shows that by the end of the recovery period, barking amplitude was significantly lower in response to DAP. Such a reduction, in response to the common occurrence of passing strangers in the kennel situation, could constitute an important welfare improvement for kennelled dogs. Barking has been shown to be a welfare problem for dogs (Sales et al., 1997).

Without further research, it is difficult to explain the reason for the fluctuations at certain points in the 1 min walk test and recovery sessions; however this could simply be due to the facilitative aspects of barking where one barking dog sets off a chain reaction around the rest of the kennel dogs. Equally, if some dogs stop barking then this may cause the other dogs to cease barking in response. It would have been interesting to note the test administrator's position in the kennel at points when barking amplitude showed a rapid decrease to see if this coincides with the position at the exit/entrance to the kennel, particularly at approximately 43 s, where there was a sharp reduction in mean barking amplitude in both the placebo and DAP treatment groups.

Interestingly in this experiment, there was no reduction in peak barking amplitude (L_{peak}) over the 1 min test or 1 min recovery period in response to DAP. This may be due to the re-homing or destruction of some of the dogs during the 7-day period of DAP exposure and the addition of newly kennelled dogs. This would mean that any new dogs may not be fully exposed to DAP for the 7-day period, therefore not allowing the pheromone to take full effect. Alternatively, DAP may not stop some dogs reaching their peak amplitude during a barking episode, but instead may only affect the number of times or length of time they bark at this peak amplitude.

Although the 'neutral stranger' results were not highly significant, there were trends in the data such as the reduction shown in barking frequency following 7 days exposure to DAP. The small sample size should also be considered when interpreting this data as the P-value for barking frequency at days 0 and 7, although greater than 0.05 ($P = 0.07$), was still high enough to warrant further testing with a larger sample size. There was also no difference in the number of transitions performed by the dogs in a period of 1 min in the absence and presence of DAP.

The friendly stranger test uncovered some interesting and significant differences in the frequency of some behaviours in response to DAP. There was an increase in resting behaviour by the dogs in response to 7 days exposure to DAP. Such an increase in resting behaviour in response to attention from a friendly stranger is arguably suggestive that they actively seek tactile contact less frequently in response to DAP.

There was a significant increase in diffuse sniffing around the kennel during the friendly stranger test. Sniffing has been shown to increase in response to pheromones in many mammals in order to increase uptake and transmission to the VNO (Beauchamp et al., 1976; Doty, 1986; Clegg and Williams, 1983). It is possible therefore, that the increase seen in sniffing during the friendly stranger test is in response to the uptake of DAP. It may also be due to exploratory behaviour towards the stranger who is displaying ‘engaging’ gestures towards the dog and this may explain why this pronounced finding was not seen during the neutral stranger test. The concept of context specific responses has not been widely explored in the scientific literature and without further study, it is difficult to offer an informed opinion on this finding.

During both the neutral and friendly stranger tests, there were many behavioural categories normally associated with stress in dogs which were unchanged in response to DAP. This may be due to the current gaps in knowledge about how DAP affects behaviour in dogs physiologically and the subsequent effects of these signals on behavioural responses in dogs. Further research should include non-invasive and minimally stressful physiological measurements of stress such as the sampling of saliva cortisol to understand the physiological basis for the observed behavioural effects of DAP seen in the present study. Recent studies on olfaction and neural processing of information received from pheromones, have demonstrated the importance of understanding the way in which odours are coded in olfactory neurons in order to fully understand the observable behavioural effects of DAP.

This study provides evidence to support the use of DAP as an effective palliative tool for reducing barking amplitude and barking frequency in kennel dogs, in response to the presence of a person walking by the kennel. This is akin to the regular presence of potential owners and staff walking by the kennels to view the dogs. Further work is needed to investigate fluctuations in barking amplitude over a period of 24 h for the full 7 days of DAP exposure, in order to gain a better understanding of the full effects of this pheromone on a longer time scale.

Finally there was a significant increase in the frequency of resting behaviour at 7 days in the DAP treatment group, in response to a friendly stranger, and a similar increase was recorded in diffuse sniffing behaviour of the kennel. These behavioural differences were not found to be highly significant during the neutral stranger test.

Although every care was taken to control for errors and inconsistencies in this study, there were several factors which could not be controlled and therefore, should be considered in the evaluation of this research. A limited sample size was obtained due to the short amount of time available for data gathering, and also due to the re-housing or destruction of dogs before completion of behavioural measurements at day 7. These limitations also had a bearing on the inequality of the group numbers in the placebo and treatment groups. The data gathered were from dogs which were present for a period of at least 7 days to allow for baseline and treatment data collection and involved batch testing over a period of 10 weeks to gather sufficient data for analysis. Data collection from other kennels was not carried out to avoid other confounding variables from the different kennel environments and differing husbandry routines.

Limited control was available over the kennel and husbandry routines, e.g. when the dog had access to the outdoor run, and when there was the introduction of a new dog to the same kennel block. Such factors may have had a bearing on the dog at the time of testing. Further research is needed to investigate the potential value of DAP as a palliative therapy to assist in more long term behavioural modification programmes, perhaps in place of current psychopharmacological agents which may induce side effects (Podberscek and Serpell, 1999).

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