



# A prospective study of two self-help CD based desensitization and counter-conditioning programmes with the use of Dog Appeasing Pheromone for the treatment of firework fears in dogs (*Canis familiaris*)<sup>☆</sup>

Emily D. Levine<sup>\*</sup>, Daniela Ramos, Daniel S. Mills

*Animal Behaviour, Cognition and Welfare Group, Department of Biological Sciences,  
University of Lincoln, Riseholme Park, Lincoln LN2 2LG, UK*

Available online 8 December 2006

---

## Abstract

The aims of this study were to evaluate the efficacy of two self-help CD based desensitization and counter-conditioning programmes with the use of Dog Appeasing Pheromone (DAP) for the treatment of firework fears in dogs and to evaluate the training progress and owner compliance. Fifty-four individuals were recruited for an 8-week period of training between August and October 2004. The dogs were separated into two treatment groups, each using a different CD based programme. After implementing the CD programme for the 8-week period without any personalized instruction, two telephone follow-up interviews were completed after periods during which fireworks are commonly used (November and January). Forty-two individuals completed the first 4 weeks of training and 38 completed the 8-week training period. Thirty-six individuals completed the first follow-up interview with 29 completing the second follow-up interview. Assessment of efficacy was measured using both owner reports of its natural response (i.e. the dog's behaviour in the home) and video footage of behaviour in response to a novel recording of the problem sound (i.e. the dog's behaviour in the behaviour clinic) pre- and post-treatment.

The majority of change with respect to the dogs' response to the CD occurred during the first month of training with no significant change during the second month of training. With respect to real exposures, there was a significant reported improvement at both follow-up interviews in both the total severity scores and the global fear scores. There was significant improvement in the mean severity score of all individual behaviours at the first follow-up with the exception of "vigilance" behaviour. Inappropriate elimination

---

<sup>☆</sup> This paper is part of the special issue entitled "Veterinary Behavioural Medicine" guest edited by Daniel Mills and Gary Landsberg.

<sup>\*</sup> Corresponding author. Tel.: +44 1522 895453; fax: +44 1522 5328.

E-mail address: [elevine@ANIMALERC.COM](mailto:elevine@ANIMALERC.COM) (E.D. Levine).

was the only behaviour to be completely resolved by the second follow-up. No difference was found in the video recordings of fear behaviours occurring in response to a novel CD recording pre-treatment versus post-treatment.

Although the CD programmes varied significantly from one another with respect to their format and the details given in their accompanying instruction booklet, there were no differences between total severity scores or global scores at follow-up two between the treatment groups.

Eighty-three percent of owners claimed to have read over 90% of the accompanying instruction booklet for their respective CD but only 48% said that the majority of the instructions were clear. Approximately 90% reported they would consider using a CD based desensitization and counter-conditioning programme again if they were to acquire another dog that was scared of fireworks.

These results suggest that the use of self-help CD based sound desensitization programmes in combination with DAP can produce a satisfactory result for some owners of dogs with fear of fireworks, but compliance may be a problem for a notable proportion of owners.

© 2006 Elsevier B.V. All rights reserved.

*Keywords:* Dog; Fear; Noise; Owner; Treatment; Welfare

---

## 1. Introduction

Noise fears and phobias among dogs (*Canis familiaris*) are a commonly reported behavioural problem (Beaver, 1999; Landsberg et al., 2003; Mills et al., 2003; Overall, 1997, 2002) with an estimated prevalence of 38% being reported (Voith and Borchelt, 1996). There are many noises of which dogs are fearful; however, the most common appear to be thunder, fireworks, and gunshots (Landsberg et al., 2003; Shull-Selcer and Stagg, 1991; Tuber et al., 1982). Being able to identify the fear eliciting situation is essential for successful treatment; however, the specific sensory channel stimulated by the trigger situation may not always be discernable. For example, thunderstorms consist of several interrelated stimuli to which the dog may be reacting (e.g. changes in barometric pressure, light intensity and ionization, in addition to the noise) and can be extremely difficult to treat as a result because of the inability to replicate these changes in the home environment. By contrast, fear of gunshots or fireworks are perhaps a more useful model for investigating treatment plans focused on the noise stimulus as many of the potential confounding non-sound related stimuli can be more easily controlled and appear less frequently implicated in the problem.

Hothersall and Tuber (1979) provide a detailed account of the use of incremental changes in the volume of recorded sounds to desensitize systematically and counter-condition two dogs in order to treat their noise fears, and since that time, the technique has become central to most treatment schedules for this problem. An abundance of individual case testimonies provide evidence of the widespread success of this method but there have been remarkably few scientific studies which have systematically examined the efficacy of other or related treatment programmes. Crowell-Davis et al. (2003) found that, for storm phobic dogs, a combination of desensitization and counter-conditioning therapy using sound recordings of storms together with medication (alprazolam and clomipramine) helped improve the reported behaviour of dogs during storms. However, there was no consistent evidence of improvement based on video recordings of the dogs' behaviour in response to the CD recordings in the veterinary hospital pre- and post-treatment. This suggests that the response to the recording in the clinic environment may not reflect the perceived response in the home environment to the real event where the behavioural modification programme has been undertaken. Sheppard and Mills (2003) suggested

that Dog Appeasing Pheromone (DAP, Ceva Santé Animale) was also useful in reducing firework-noise-related fear behaviours, even without the use of systematic desensitization and counter-conditioning, as long as the owners ignored the dog's fearful behaviour. A retrospective study which examined the effect of various treatment plans with dogs who had firework fears (Mills et al., 2003) found that the combination of DAP and a CD recording based programme (Fear of Fireworks, <http://www.Fearoffireworks.com>) provided a stronger therapeutic result than either the recording or DAP alone. The authors also found that owners who used medication (acepromazine, diazepam) to help in the management of the problem were less compliant with certain aspects of the behaviour modification programme and tended to report no improvement in their dog's behaviour as a result of treatment. Such medication is only available on prescription from a veterinarian and the results of this latter study emphasize the importance of behaviour therapy in the management of these cases. It should be noted that acepromazine is a sedative and not an anxiolytic and that diazepam is most efficacious as an anxiolytic when administered prior to the noise event. Desensitization and counter-conditioning can be time intensive, laborious and confusing for inexperienced individuals. Theoretically, the desensitization and counter-conditioning programmes should be applied in a structured manner to maximize the chances of success and avoid exacerbating the fear through inadvertent noise sensitization. Whilst there are behaviour specialists to help design individual treatment programmes for their clients, there are also a range of commercially available tape and CD based self-help programmes advertised for the treatment of noise fears in dogs. These recordings vary in sound quality, structure, and content, together with the instructions provided. For example, Fear of Fireworks (<http://www.Fearoffireworks.com>) is based on a live recording of fireworks, whilst Sounds Scary (Sounds Scary Ltd.) is a more formally structured programme based on sound segments and sequences. To date, there have been no systematic studies of the efficacy of these self-help desensitization and counter-conditioning programmes, nor the problems that might arise. Therefore the aims of this study were, firstly to evaluate the efficacy of two self-help CD based behaviour programmes for the treatment of firework noise fears and secondly, given the lack of personalized instruction, it was of interest to examine training progress and owner compliance and interpretation of the instructions provided with these programmes in a self-help package. Efficacy would be assessed using both owner reports of the dog's behaviour to live events while the dog was in the home and video footage of the dog's response to a segment of a firework CD in the behaviour clinic pre- and post-treatment. The latter allows a more objective determination of whether, in the case of firework fears, the behaviour of the dogs in the clinic in response to a CD recording corresponded with their reported behaviour in response to the live event at home. The efficacy of the two CD programmes would then be compared using the owner reports as, ultimately, it is the owner's impression of improvement that will dictate if a treatment is deemed useful.

## **2. Materials and methods**

### *2.1. Participants and animals*

Participants were recruited via notices at local veterinary clinics and a press release to the local media. The dates of the study were August through October 2004. Telephone interviews with potential participants were completed to ensure they met the following inclusion criteria: the dog was at least 6 months old, displayed fear responses identifiable to fireworks, displayed the fear responses in the home, had not generalized the fear such that the fear eliciting cues were too numerous to be counted or the dog was generally anxious, and were not receiving any psychoactive medication. In addition, the owner had to be willing to keep a daily diary, not anticipate a break of more than 15 days away from home over the next 3

months, and be willing to receive weekly phone calls for monitoring purposes. Those that met the inclusion criteria, were sent a behavioural history form, a baseline firework fear behavioural questionnaire, and a self-addressed and stamped envelope. In August 2004, a general meeting was held at the University of Lincoln's Animal Behaviour Clinic for all potential participants who had dogs that appeared to have firework fears based on the aforementioned constraints to discuss the objective of the study, review what would be required of them throughout the 8 weeks with regards to diary keeping, and to confirm informed consent. Owners were not informed about how to implement the treatment programme beyond being told to read the instruction booklet that accompanied their CD. However, they were told to call the University's behaviour clinic at any time if they had questions about implementing the treatment programme. The participants' regular veterinarian also provided written permission for their clients to participate in the study. Each dog received a physical examination prior to trial enrolment to exclude medical differentials that required separate treatment and the examination was administered by the same qualified veterinary behaviourist (DM). Dogs with separation anxiety or aggression directed at veterinarians (which prevented the required initial physical exam without restraint) were excluded from the study. During the initial consultation all dogs were individually videotaped in the University's behaviour clinic while being exposed to a segment of a firework track from the "Sounds for behaviour therapy CD" recording (Company of Animals Ltd.). At the end of the 8-week trial all dogs were brought back into the clinic and were videotaped again while listening to the same recording (i.e. not the one used for training purposes).

Owners were instructed to read and follow the instructions (both of which suggest using DAP) that accompanied their respective CD. The owners were not given any further clarification of the directions that accompanied the CD at this time. Half of the participants received a programme called Fear of Fireworks and the other half a programme called Sounds Scary. The distribution of the CDs to participants was matched based on initial owner perceived global severity scores. Both programmes recommend the use of DAP. In order to help ensure even compliance with the use of pheromone therapy, DAP was distributed to all participants free of charge. Owners were provided with diaries to complete detailing aspects of the CD training. Information collected included, but was not limited to, how many times a day they played the CD, did they begin the CD when the dog was relaxed, and noting if the DAP diffuser still contained the liquid. In addition, owners were provided with real exposure diary supplements in which they noted the behaviours their dogs exhibited and the owner's response to the behaviour (e.g. did they ignore the dog). Throughout the 8-week study, all participants were called once a week and were asked questions pertaining to the use of the CD (e.g. how many times did you play the CD this week, did you reach full volume) and the dog's behavioural response to the recording (i.e. frequency and intensity of individual fear-related behaviours). It became apparent at the first telephone consult, that owners had variable interpretations of the concept of a "safe haven" area which is described in both sets of instructions and so in order to reduce uncontrolled error and standardize use of a "safe haven", so that we could focus the study on the many variable of interest (i.e. the differing properties of two products), owners were given specific instructions on what constituted a "safe haven". A safe haven was described as a location in the home in which the dog had only positive experiences. The owners were instructed not to use the location to which the dog normally hides when he or she is fearful if in fact the dog still shows signs of anxiety or fear in this location. At the week 4 follow-up, all owners were given basic information pertaining to some key principles of using desensitization and counter-conditioning programmes with respect to fear of noises in light of commonly identified errors relating to the use of the programmes (e.g. explaining what ignoring entails). Two telephone follow-up interviews were completed following times during which fireworks are traditionally used in the UK (5 November, 31 December). The first follow-up interview was conducted in mid-November. The second follow-up interview was conducted in mid-January. During the time between these follow-up interviews, owners were not instructed specifically to use the CD or the DAP. Data were only collected on fear-related behaviours and on owner opinions on the efficacy of the CD therapy if the dogs had experienced real exposures during the time frame between follow-up interviews.

Fifty-four dogs with firework fears were initially enrolled in the prospective study and the protocol was approved by the relevant University of Lincoln's Research Ethics Committee.

## 2.2. Behaviour assessment

### 2.2.1. Efficacy to real exposures

The behavioural questionnaire contained questions pertaining to the behavioural and medical history of the animal and was adapted from the history form used in the University of Lincoln's Animal Behaviour Clinic (available upon request from the author). In the firework fear questionnaire, used at baseline and the two follow-up interviews, owners identified both the frequency and the intensity of individual fear-related behaviours in which their dogs engaged during fireworks while inside the home. Answer options for frequencies of behaviours were never (0), rarely (1), frequently (2), and every time (3). Answer options about intensity of a behaviour were numerical ratings from 1 to 5 with 1 being a small amount and 5 being an extensive amount. The *severity* of individual behaviours was calculated from multiplying the frequency by the intensity of that behaviour. The total severity score for each dog was calculated by summing the severities of each behaviour. The total severity scores were then converted into percentages by dividing each individual total severity score by the total possible severity score. The owners were also asked to assign a *global* score on a scale from 0 to 10 relating to their perception of their dogs' firework fear. Zero related to a mild fear response whereas 10 was the most severe fear response imaginable. An option to say there was no fear present was also provided at follow-up. For both follow-up interviews owners were asked to give a global fear score.

With regards to evaluating efficacy using the video recordings, an ethogram was constructed of fear-related behaviours (Table 1). The dogs were exposed to the same soundtrack and videotaped over a period including the same 60 s segment of the "Sounds for behaviour therapy CD". Focal sampling with one-zero recording of the behaviours was used every 10 s for the latter 60 s of the recording. There were a total of six 10 s periods. This same method was used for both the pre- and post-CD training.

### 2.2.2. Training progress and owner compliance

During the weekly phone interviews, the owners were asked about their dog's behaviour to the recorded firework noises. The owners reported both the frequency and the intensity of the same 17 behaviours asked about in the baseline firework fear questionnaire. Total severity scores for individual behaviours were calculated as before from multiplying the frequency score by the intensity score. Two dogs on the trial were not included in the final analysis as they were not responsive to either CD at normal or high volumes; therefore, their progress could not be evaluated with this methodology.

Multiple questions pertaining to owner satisfaction were asked at each follow-up interview. The answer options for such questions were categorical (e.g. how satisfied are you with the effect you have seen from this therapy? Very satisfied, moderately satisfied, mildly satisfied, not satisfied at all). Questions pertaining to owners voluntary continuation of the CD and DAP were asked during the second follow-up interview. All answer options were categorical.

Table 1

Ethogram used for assessing behaviour of dogs in response to CD recording in the clinic

---

Panting: open mouth breathing
Shaking: rapid vibration of whole body
Cowering: crouching, lowering of body (not all the way to the ground)
Hiding: positioning oneself underneath an object
Seeks owner: moves towards/remains in close proximity to the owner
Vigilance: alertness, moving head side to side appearing to scan the environment
Pacing: repeated walking locomotion over the same area
Barking: vocalization. Non-continuous sound. Mouth must open and close in order to produce this sound
Whining: prolonged vocalization for which the mouth remained closed; a continuous sound
Running: faster locomotion than pacing
Clawing at door: repeated extension and retraction of forelimbs against the base of the door
Frozen/static: no movement. Dog alert

---

### 2.3. Data analysis

All data were analyzed using Minitab 13.0 (Minitab Ltd.).

#### 2.3.1. Efficacy of treatment programmes to real exposures

Data from all subjects were analyzed prior to dividing the subjects into their respective CD groups for comparative analyses. In order to maximize the use of available data, a system of imputation was used where there were missing data (Longford et al., 2000). For individuals who neglected to answer one measure (e.g. either frequency or intensity) for a maximum of two behaviours, data was imputed using the mode of the corresponding missing value. There were six individuals who met the criteria for data imputation. Five of these individuals did not answer one measure for one behaviour. One individual did not answer one measure for two behaviours. Frequency histograms of these data were compared before and after data imputation to ensure that the distribution was not affected.

Total severity scores were calculated for each dog prior to the treatment programme (baseline total severity scores) and at each follow-up interview. The data were not normally distributed and therefore were analyzed using non-parametric techniques. The Sign test was used to analyze the difference in pre- and post-treatment total severity scores, global scores, and in individual fear-related behaviours for all dogs. When analyzing severity scores for individual behaviours, the only subjects included were those for whom all the data were available (i.e. baseline, follow-up one and two). The Wilcoxon–Sign test was used because it is a more conservative test than the Wilcoxon rank test in that it does not take magnitude of change into consideration. This was felt most appropriate because these data were collected from owner impression and therefore the test would minimize bias due to owner differences in scoring. To determine the percentage of improvement of each behaviour between baseline and follow-up one and between baseline and follow-up two, the population prevalence of a behaviour was also used. Any dog for whom we did not have prevalence data for the first follow-up was excluded from the baseline “*N*” in order to prevent biasing the data. The same procedure was used for measuring percentage of improvement from baseline to follow-up two. To determine the level of population improvement, the individual behaviours were then weighted according to the percentage of dogs that exhibited that respective behaviour at baseline; therefore, commonly exhibited behaviours were given more weight. In order to determine if there was correlation between the change in global scores with the change in total severity scores from baseline to follow-up one, a Pearson’s rank correlation coefficient was used. To determine if there was a difference with respect to real exposures for each CD group, a Mann–Whitney *U*-test was used. The total number of real exposures for each CD group were summed from the daily diaries provided to the owners and compared.

A total recorded frequency score was calculated from analysis of the video footage, for each fear-related behaviour using a one-zero method of sampling (Martin and Bateson, 1993). This method provides a relatively simple method of quantifying behaviour and is suitable when trying to establish if a behaviour has been eliminated as a result of treatment. Each dog was recorded for 60 s; however the first 10 s of the video footage was not included due to some owners restraining the dog during this time. Therefore only the behavioural data from the 20 to 60 s period was used. The possible scores for each behaviour therefore ranged from 0 to 4. To determine if there was a difference between the pre- and post-fear scores for each behaviour and to determine if there was a difference between total fear scores (i.e. all behaviours summed) pre-treatment versus post-treatment, a Wilcoxon–sign rank test was used.

#### 2.3.2. Training progress and owner compliance

Data from all subjects were analyzed prior to dividing the subjects into their respective treatment groups for specific and comparative analyses. For individuals to be included in the data analysis, they had to complete at least the first month of training. This was deemed necessary in order to provide a reasonable time period during which to monitor the dog’s behavioural response to the recordings. Differences between the two groups in the categorical variables gender, age, and breed were assessed using chi-squared tests. To determine if there were differences in the reported baseline frequency and severity with which individual behaviours occurred between dogs receiving the FOF CD and those receiving the SS CD, a Mann–Whitney

*U*-test was used. Total severity scores were calculated for weeks 1, 4, 5, and 8 of the trial (8-week CD training) to evaluate the dogs' response to the recording itself. The Wilcoxon–Sign test was used to analyze the differences between the total severity scores between weeks 1 and 4, between weeks 5 and 8, and between weeks 1 and 8. The Wilcoxon–Sign test was also used to analyze differences in severity between individual behaviours after the first and second month of CD training compared to baseline data obtained prior to the start of the study. Individual behaviours for which the sample was less than or equal to 5 were excluded from statistical analysis.

Descriptive statistics were collected for questions relating to owner ability to understand and apply the training instructions. Data were collected relating to the owners' overall satisfaction with the treatment therapy, if they would use this treatment programme again in the event that they acquired another dog that was fearful of fireworks. The percentage of owners that continued to use the CD and DAP following the follow-up interviews was also collected. In order to evaluate if the continued use of these products were associated with degree of change from baseline to the first follow-up, a chi-square test was used. The median percent change in the total severity score from baseline to follow-up one was used to divide the population into two groups. Yes or no variables were then compared to the aforementioned two groups for continued use of the CD and then for continued use of the DAP.

### 3. Results

#### 3.1. Population characteristics

Forty-two individuals completed the first 4 weeks of training. Of these, 17 of the recruited dogs were mixed breeds and 25 were pure breeds. The breeds represented included Collies (6), Retrievers (4), Terriers (4), German Shepherds (3), Cocker spaniels (2), Greyhound (1), Miniature Schnauzers (1), Shit-zus (1), St. Bernards (1), Staffordshire bull terriers (1), and a Whippet (1). There was no gender ( $\chi^2 = 0.382$ , d.f. = 1,  $p > 0.05$ ), age ( $\chi^2 = 0.008$ , d.f. = 1,  $p > 0.05$ ), or pedigree status (i.e. pure breed versus mixed breed) ( $\chi^2 = 0.221$ , d.f. = 1,  $p > 0.05$ ) difference between the two treatment groups receiving FOF CD versus those receiving SS CD (Table 2). Whilst the median severity score of panting was higher for dogs receiving the FOF CD ( $p < 0.05$ ), the two groups of dogs were considered to be behaviourally similar as there were no differences in the severity ( $p > 0.05$ ) of any other behaviours or in the frequency ( $p > 0.05$ ) of any of the behaviours.

Table 2  
Demographic data for dogs that completed at least 1 month of training

	Both CDs	FOF CD	SS CD
Age range (median)	1.5–19 years (6.5 years)	1.5–10 years (6.7 years)	3–19 years (6.5 years)
Gender			
MI	7	4	3
MN	15	8	7
FI	4	1	3
FN	16	8	8
Breed			
Pure breed	25	14	11
Mixed breed	17	7	10
$N^a$	42	21	21

<sup>a</sup> The two dogs that tried both CDs and were non-responsive are not included in the above table.



In addition, there were no differences between the groups of dogs with respect to the number of real firework exposures that occurred during the training period ( $W = 339.5$ ,  $p > 0.05$ ) (median = 1 for both groups).

### 3.2. Efficacy of treatment to real exposures

#### 3.2.1. All subjects

Thirty-six owners completed the first follow-up (mid-November) and 29 completed the second follow-up (mid-January).

Dogs showed significant improvement in their total severity scores at both follow-up one (Sign test,  $p < 0.001$ ) and follow-up two (Sign test,  $p < 0.001$ ) when compared to their baseline total severity scores but showed no significant change between the follow-up interviews (Sign test,  $p = 1.0$ ) (Fig. 1). The behaviours aggression, self-mutilation, and inappropriate elimination were excluded from analysis as they occurred in five or fewer subjects; therefore, 14 specific behaviours were included in the analysis. With respect to the mean severity scores for these individual behaviours, there was significant improvement for 12 of the 14 behaviours at both the first and the second follow-up (Fig. 2). Vigilance (i.e. scanning the environment) did not show significant improvement until the second follow-up and was the behaviour that was least improved. Running around showed significant improvement at the first follow-up but this improvement was not sustained by the second follow-up.

At least 70% of the dogs exhibited the following eight behaviours at baseline: hiding, cowering, pacing, panting, owner seeking, vigilance, startling, and shaking (Fig. 3). The level of general improvement within the population using the weighted prevalence data suggested there was a median reduction of 59% (mean 54%) in signs shown per dog. There was however great individual variation among the different signs (Fig. 3 and Table 3). The behaviour “running around” significantly improved during the first follow-up but the improvement was not sustained by the second follow-up. Owner seeking behaviour was least improved at the second follow-up

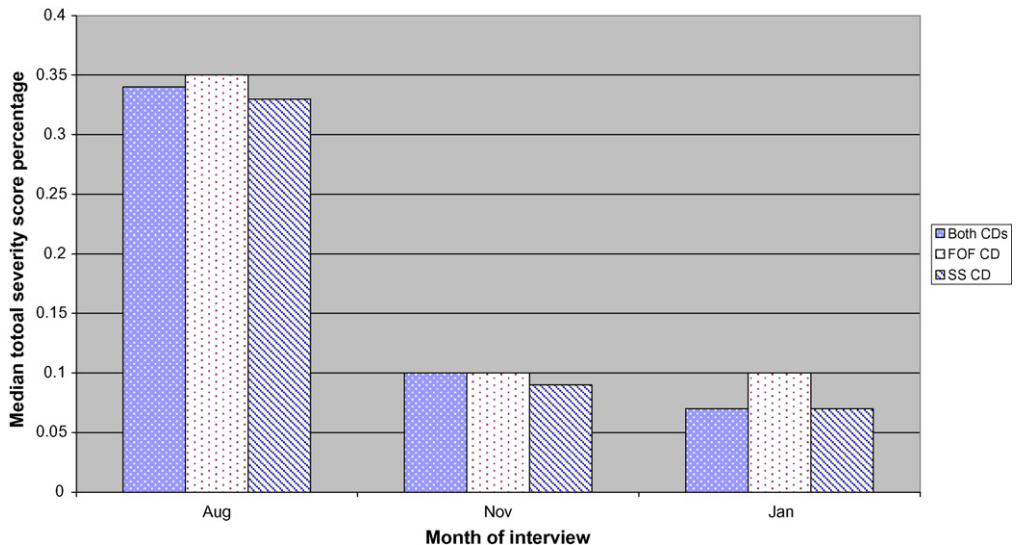


Fig. 1. Median total severity score percentage at baseline and follow-ups subdivided into CD categories.



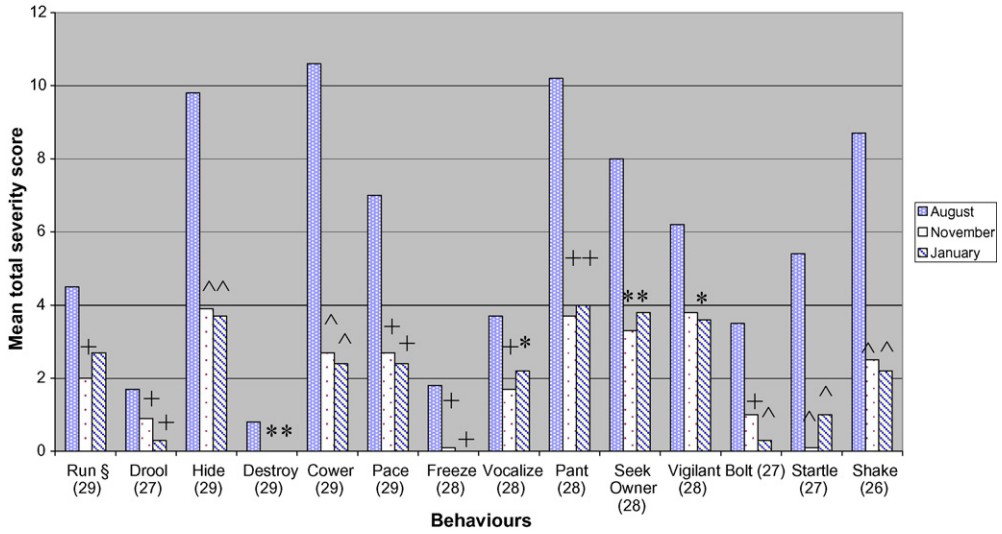


Fig. 2. Mean total severity scores of individual behaviours at baseline and follow-ups for all dogs. §: number in parenthesis is the number of dogs showing signs at baseline followed up to January. All levels of significance of difference relative to August baseline. \*  $p \leq 0.05$ ; †  $p \leq 0.01$ ; ^  $p \leq 0.001$ .

(Table 3). There was no significant change in the severity of any of the individual behaviours between follow-up one and follow-up two (Sign test,  $p > 0.05$  for all behaviours).

The owners reported a significant improvement in their global assessment scores when comparing baseline (median = 8) to follow-up one (median = 5) and follow-up two (median = 6) (Sign test,  $p < 0.001$  for both comparisons). There was no difference between the follow-up interviews (Sign test,  $p > 0.1$ ). The changes in the global fear score reflected the changes in the total severity score as there was a significant correlation between the improvement in the global

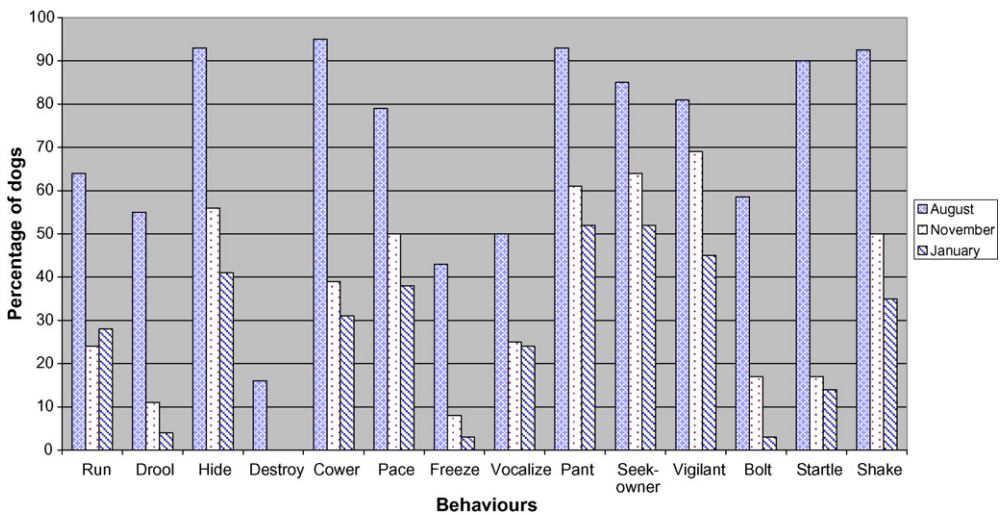


Fig. 3. Prevalence of behaviours of all dogs at baseline and follow-ups.

Table 3

Percent change in prevalence of individual behaviours from baseline to follow-up one and follow-up two

Behaviours	Baseline to follow-up one		Baseline to follow-up two	
	N <sup>a</sup>	% improvement	N <sup>a</sup>	% improvement
Run	25	64	21	62
Drool	20	80	17	94
Hide	34	41	32	62.5
Destructive	6	100	6	100
Cower	34	59	30	70
Pace	29	38	28	61
Freeze	14	78	17	92
Vocalize	20	47	18	61
Pant	33	33	29	48
Seek-owner	25	34	23	35
Vigilant/scan	30	17	25	48
Bolt	21	71	20	95
Startle	30	80	29	86
Shake/tremble	31	42	26	61.5

<sup>a</sup> The dogs used to report baseline values were subjects for which there were related data at the respective follow-up.

fear score and the total severity score when measured from baseline to follow-up one (Pearson  $\rho = 0.711$ ,  $p < 0.001$ ). In addition, there was a correlation between owner satisfaction and the reported change in both the global score (Pearson  $\rho = 0.731$ ,  $p < 0.001$ ) and the total severity score (Pearson  $\rho = 0.591$ ,  $p < 0.001$ ) at the first follow-up interview. Seventy-eight percent of owners reported some degree of improvement in their dog's behaviour (Table 4). Between the first and second follow-up interviews, the owners were not required to use either the CD or the

Table 4

Percentage of owners that reported various degrees of behavioural improvement, satisfaction with the results from using the CD therapy, and reported likelihood that they would use CD therapy again if they were to acquire another dog that was scared of fireworks

	Both CDs		FOF CD		SS CD	
	November (n = 36)	January (n = 28)	November (n = 17)	January (n = 13)	November (n = 19)	January (n = 15)
<b>Improvement</b>						
None	17%	22%	35%	38%	0%	7%
Slight	22%	7%	12%	0%	32%	13%
Moderate	28%	32%	12%	31%	42%	33%
Great	30%	39%	41%	31%	21%	47%
Slightly worse	3%	0%	0%	0%	5%	0%
<b>Satisfaction</b>						
None	22%	18%	35%	31%	10.5%	7%
Mild	11%	4%	12%	8%	10.5%	0%
Moderate	28%	25%	12%	23%	42%	27%
Very	39%	53%	41%	38%	37%	66%
<b>Use CD therapy again</b>						
No	3%	3.5%	0%	0%	5%	7%
Yes	92%	93%	88%	92%	95%	93%
Do not know	5%	3.5%	12%	8%	0%	0%

DAP. Of the 34% of owners who continued using the CD, 80% played it up to four times per week with the majority of sessions lasting  $\leq 15$  min (Table 5). There was no association between percentage of improvement at the first follow-up interview and the continued use of either the CD ( $\chi^2 = 0.157$ , d.f. = 1,  $p > 0.05$ ) or the DAP ( $\chi^2 = 2.253$ , d.f. = 1,  $p > 0.05$ ).

With respect to the analysis of the video footage, there was no difference in the pre- and post-treatment scores of individual behaviours or between total scores (summed behaviours) (Wilcoxon,  $p > 0.05$  in all circumstances).

### 3.2.2. Individual treatment programmes

*FOF.* Seventeen owners completed follow-up 1 and 14 completed follow-up 2. Dogs showed significant improvement in their total severity scores at both follow-up one (Sign test,  $p < 0.001$ ) and follow-up two (Sign test,  $p < 0.001$ ) when compared to their baseline total severity scores (Fig. 1); however, there was no significant change between the follow-up interviews (Sign test,  $p > 0.1$ ). Regarding individual behaviours, there was a significant improvement in seven behaviours at follow-up one [running around ( $p < 0.05$ ), hiding ( $p < 0.01$ ), cowering ( $p < 0.001$ ), panting ( $p < 0.05$ ), bolting ( $p < 0.01$ ), shaking ( $p < 0.01$ ), and startled ( $p < 0.001$ )] and an improvement in eight behaviours [drooling ( $p < 0.05$ ), hiding ( $p < 0.01$ ), cowering ( $p < 0.001$ ), pacing ( $p < 0.05$ ), panting ( $p < 0.05$ ), bolting ( $p < 0.01$ ), shaking ( $p < 0.05$ ), and startling ( $p < 0.001$ )] at follow-up two with no significant change in any individual behaviours between the follow-ups (Sign test,  $p > 0.1$  for all behaviours). In this group of dogs the behaviour “running around” improved only for the first follow-up whereas, the behaviours drooling and pacing did not show significant improvement until the second follow-up. There was no significant improvement with respect to the global scores when comparing baseline (median = 8) to follow-up one (median = 7) (Sign test,  $p > 0.05$ ); however, owners reported a significant improvement in global scores when comparing baseline scores to the second follow-up scores (median = 6.5) (Sign test,  $p < 0.05$ ). In addition, no difference was found in global scores between the follow-up interviews (Sign test,  $p > 0.1$ ).

Sixty-two percent of owners stated that there was some degree of improvement in their dog’s behaviour and nearly all individuals stated that they would consider using firework CDs as a

Table 5

Decisions of individuals to continue the use of DAP and the use of the CD between follow-up one and follow-up two and characteristics of the CD use percentages, for those who did continue the use of the CD, expressed as a proportion of that subpopulation

	Continued using the CD		Number of times per week the CD was played		Length of time the CD was played per session (min)		Continued the use of DAP <sup>a</sup>	
Both programmes ( <i>n</i> = 29)	Yes	34%	Up to four times	80%	$\leq 15$	66%	Yes	34%
	No	65%	Five to eight times	20%	16–30	34%	No	45%
Fear of fireworks ( <i>n</i> = 13)	Yes	23%	Up to four times	67%	$\leq 15$	33%	Yes	46%
	No	77%	Five to eight times	33%	$> 15$	67%	No	31%
Sounds scary ( <i>n</i> = 15)	Yes	47%	Up to four times	86%	$\leq 15$	83%	Yes	21%
	No	53%	Five to eight times	14%	$> 15$	17%	No	64%

<sup>a</sup> Some individuals reported that the DAP ran out at some point between the follow-up one and follow-up two interviews; therefore, the percentages reported are only for those who either used the DAP consistently between follow-up one and follow-up two or those who did not use at all within this time frame.

method of helping other dogs they acquire that may have firework fears (Table 4). Twenty-three percent of individuals continued the use of the CD after follow-up one (Table 5).

*SS CD.* Nineteen owners completed follow-up one and 15 completed follow-up two. Dogs showed significant improvement in their total severity scores at both follow-up one (Sign test,  $p < 0.001$ ) and follow-up two (Sign test,  $p < 0.001$ ) when compared to their baseline total severity scores (Fig. 1). There was no significant change between the follow-up interviews (Sign test,  $p > 0.1$ ). With respect to individual behaviours, there was significant improvement in six behaviours [hiding ( $p < 0.05$ ), cowering ( $p < 0.01$ ), pacing ( $p < 0.01$ ), panting ( $p < 0.05$ ), shaking ( $p < 0.01$ ), and startled ( $p < 0.001$ )] at follow-up one and an improvement in six behaviours [cowering ( $p < 0.001$ ), pacing ( $p < 0.05$ ), owner seeking ( $p < 0.05$ ), bolting ( $p < 0.01$ ), shaking ( $p < 0.05$ ), and startled ( $p < 0.01$ )] at follow-up two when compared to baseline scores. Hiding and panting behaviour significantly improved at follow-up one, but did not show significant improvement at follow-up two. The behaviours of “seeking the owner” and “bolting” did not show significant improvement until the second follow-up. There was no significant change in any individual behaviours between follow-up one and follow-up two ( $p > 0.1$  for all behaviours). Owners reported significant improvement with respect to the global scores compared to baseline (median = 8) for both follow-up one (median 5) and follow-up two (median = 5) (Sign test,  $p < 0.001$  for both comparisons). There was no difference in global scores between the follow-up interviews (Sign test,  $p > 0.1$ ).

Ninety-three percent of owners stated that there was some degree of improvement in their dog's behaviour and nearly all owners stated that they would consider using firework CDs as a method of helping other dogs they acquire that may have firework fears (Table 4). Forty-seven percent continued to play the CD in between follow-ups (Table 5).

*3.2.2.1. Comparison of FOF and SS programme.* Whilst there was no overall difference between the SS and FOF CD in the improvement from baseline to follow-up one ( $W = 353.0$ ,  $p > 0.1$ ) or follow-up two ( $W = 221$ ,  $p > 0.1$ ), more behaviours (i.e. 8 versus 6) were reported to have decreased at the second follow-up for those dogs using the FOF programme. There was no difference between changes in owner reported global scores from baseline to follow-up one ( $W = 370$ ,  $p > 0.1$ ) or follow-up two ( $W = 240$ ,  $p > 0.1$ ) between the two groups of dogs.

### 3.3. Training progress and owner compliance

#### 3.3.1. All subjects

With an initial population of 54 individuals, 42 (78%) completed the first 4 weeks of training and 36 (67%) completed the 8-week training period. Reported reasons for owners not completing the study varied but included lack of time to play the CD and family or personal health reasons. One individual strongly disagreed with the idea of giving treats as a method of counter-conditioning. There was no significant difference between the drop out rates for the CD groups at either week 4 ( $\chi^2 = 0.324$ , d.f. = 1,  $p > 0.05$ ) or week 8 ( $\chi^2 = 1.836$ , d.f. = 1,  $p > 0.05$ ) and the reasons for dropping out appeared similar between the groups.

With respect to the total severity scores, which included all behaviours, dogs exhibited a significant reduction in their behaviour towards both CDs after the first month of training (Sign test,  $p = 0.0001$ ) (Fig. 4a). No further change was noted during the second month of training (Sign test,  $p > 0.05$ ). Six specific behaviours were excluded from statistical analysis due to small sample size. These behaviours included drooling ( $n = 4$ ), destruction ( $n = 3$ ), aggression ( $n = 0$ ), vomiting/urination/defecation ( $n = 0$ ), bolting ( $n = 3$ ), and self-harm ( $n = 0$ ). Of the remaining 11

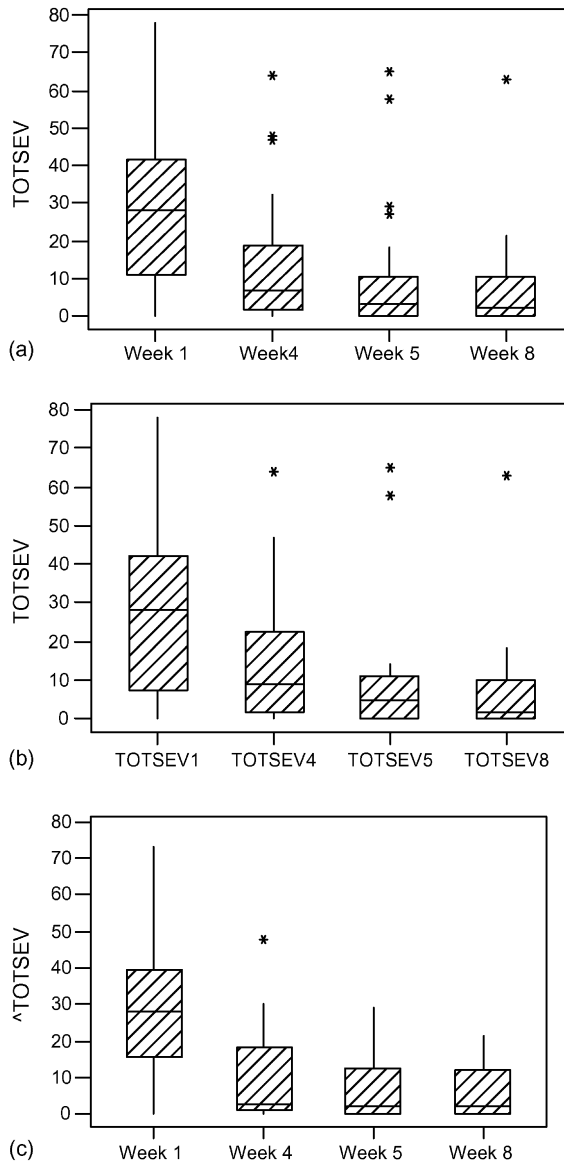


Fig. 4. Median and interquartile range for total severity scores for dogs at the end of weeks 1, 4, 5, and 8 of the CD training period for all dogs (a), dogs in the FOF treatment group (b), and dogs in the SS treatment group (c). Key. Box and Whisker plots: the data represented within the box represents the middle 50% of the population with the horizontal line within the box representing the median score. ^TOTSEV: the total severity score and \*: outliers

analyzed behaviours, a significant reduction during the first month of training was found in 7 of the behaviours. These behaviours included hiding (Sign test,  $p < 0.05$ ), cowering (Sign test,  $p < 0.001$ ), panting (Sign test,  $p < 0.05$ ), owner seeking behaviour (Sign test,  $p < 0.001$ ), scanning ( $p < 0.01$ ), exaggerated response when startled (Sign test,  $p < 0.001$ ), and shaking (Sign test,  $p < 0.001$ ).

At the start of the training period, 83% of the participants reported reading greater than 90% of the accompanying instruction booklet with only 48% stating that the majority of the booklet was clear to understand. Fifty-five percent of individuals believed that the majority of the programme would be easy to follow.

### 3.3.2. Individual treatment programmes

*FOF.* Twenty-one dogs (78%) completed the first 4 weeks of the training and 17 (63%) completed the 8 weeks of training. Dogs in this group exhibited a significant reduction (Sign test,  $p < 0.05$ ) in their total severity scores in response to the CD during the first month of training but no further change during the second month of training (Sign test,  $p > 0.1$ ) (Fig. 4b). Despite the significant change in the total severity scores, only three of the nine behaviours showed a significant reduction: cowering (Sign test,  $p < 0.05$ ), panting (Sign test,  $p < 0.05$ ), and scanning (Sign test,  $p < 0.05$ ).

At the start of the training period, 90% of the participants reported reading greater than 90% of the accompanying instruction booklet with only 52% stating that the majority of the booklet was clear to understand. Fifty-two percent of individuals believed that the majority of the programme would be easy to follow. At the end of training week 8, when asked how easy the treatment plan was to follow, 82% responded easy, 12% responded difficult, and 6% responded in between easy and difficult.

*SS.* Twenty-one (84%) completed the first 4 weeks of the training and 20 (81%) completed the 8 weeks of training. Dogs in this group exhibited a significant reduction (Sign test,  $p < 0.01$ ) in their total severity scores in response to the CD during the first month of training but no further change during the second month of training (Sign test,  $p > 0.1$ ) (Fig. 4c). Five of the nine behaviours showed significant reduction in this group of dogs: hiding (Sign test,  $p < 0.05$ ), cowering (Sign test,  $p < 0.001$ ), panting (Sign test,  $p < 0.01$ ), owners seeking behaviour (Sign test,  $p < 0.01$ ), and shaking (Sign test,  $p < 0.05$ ).

At the start of the training period, 76% of the participants reported reading greater than 90% of the accompanying instruction booklet with only 42% stating that the majority of the booklet was clear to understand. Fifty-seven percent of individuals believed that the majority of the programme would be easy to follow. At the end of training week 8, when asked how easy the treatment plan was to follow, 71% responded easy, no one responded difficult, and 29% responded in between easy and difficult.

## 4. Discussion

### 4.1. Efficacy of CDs to real exposures

These results describe the potential value of using sound recordings of fireworks with the use of DAP as a treatment plan for dogs with firework fears. Behaviours that occurred most commonly (i.e.  $>70\%$  of the dogs) to real fireworks included hiding, cowering, pacing, panting, seeking the owner, shaking, vigilance, and having an exaggerated response when startled. This is similar to findings in an earlier study using owner reported information regarding fear behaviours exhibited by dogs exposed to real fireworks (Sheppard and Mills, 2003). In a study by Crowell-Davis and colleagues, the most common fear-related behaviours exhibited by dogs with storm phobia ( $>70\%$ ) appear similar to those shown in dogs with firework fears, but cowering and startle responses were not evaluated. Although direct comparisons between the studies are of limited value due to differences in methodology and complexity of the fear eliciting stimuli, there

are some similarities in the outcomes, such as the rate of improvement that should not be overlooked. In the present study, the total severity scores significantly improved by the first follow-up (day 60) and were maintained at the second follow-up (day 120). Crowell-Davis et al. (2003) reported in thunder phobic dogs the fear scores decreased over a 120-day period. Together, these results suggest that significant improvement can be seen as soon as 60 days, but encouraging owners to continue the treatment for at least 4 months could further decrease the fear-related behaviour. It is important to highlight the trend in both studies that the dogs had a greater percentage of improvement in individual behaviours across a 120-day time period. Further studies are needed to investigate the ideal length of time that treatment should continue and/or to measure the duration of efficacy after owners have ceased treatment.

Although the changes in global scores from baseline to both follow-ups showed significant improvement, it is worth noting that the median global score at baseline was 8 and at the first follow-up was 5, but rose to 6 at the second follow-up. A difficulty in the interpretation of these particular scores is the potential lack of validity in using owner reported global scores as meaningful measures of improvement. However, given that the change in global scores correlated with the change in total severity scores, it appears that, for this study, the global scores had some validity as a measure of behavioural improvement; however, they may or may not reflect the magnitude of improvement. It is possible that the global assessment scores may be identifying components of the fear behaviour (e.g. overall emotional state of the animal) that are not revealed by simply scoring individual behaviours. Thus, it may be that the global score gives a more accurate picture of the animal's overall fear or anxiety. Mills et al. (2006) have recently argued that reliable global measures of emotional state may be more sensitive measures of treatment response than specific behaviours in studies such as this. If this is the case, the efficacy of the CD based programme may not be as great at reducing the dogs' fear of fireworks as the behavioural score changes may indicate. Alternatively, it could be argued that the owners' report of the global assessment may be influenced by external factors such as ease of understanding, implementation of the programme, or owner expectation about behavioural changes and therefore, may not be reflecting accurately the dog's behavioural improvement. Further research is needed to validate the use of owner reported global scores.

With respect to the prevalence of behaviours, approximately 60% of initially reported behaviours were no longer exhibited; however, there was variation with respect to which behaviours ceased; therefore, which behaviours an individual dog shows may affect the overall number of behavioural signs stopped. With respect to the severity of individual behaviours, all behaviours assessed with the exception of "vigilance" improved significantly by the first follow-up. Vigilant behaviour improved by the second follow-up. The delay of improvement in "vigilance" may be related to the potential function of this behaviour. Vigilance may be related to the orienting response. Identifying the source of a potentially threatening sound would be evolutionarily advantageous, as locating the source of the sound would give the animal information to help execute the most appropriate behaviours, e.g. running in a direction away from the source. Therefore, it may be expected that this particular behaviour will take longer to dissipate than behaviours such as panting and trembling which do not have the potential to provide information to the animal but are an expression of a more intense emotional response. Although the severity of "inappropriate elimination" behaviour could not be analyzed statistically due to the small sample size for which all follow-up information was available ( $n = 5$ ), it should be noted that all five dogs stopped the behaviour by the second follow-up. However, the dog with highest severity score for inappropriate elimination dropped out of the training programme. All dogs which showed inappropriate elimination in the Crowell-Davis



study ceased the behaviour completely by day 120 but it should be noted that in this latter study all subjects were also treated with anxiolytic medication.

With respect to the individual CD programmes, there was no significant difference between the number of behaviours that improved at either follow-up one or follow-up two.

All of the behavioural data reported thus far have been collected using owner reports which may not be the most accurate method of assessment; therefore video footage of the animals was also assessed. No improvement in fear-related behaviours was seen post-treatment when the animals were exposed to a segment of a firework track while in the behaviour clinic. This is a similar finding to that of Crowell-Davis and colleagues in which storm phobic dogs showed no improvement to storm recordings in the clinic but showed significant owner reported improvement in the home setting (Crowell-Davis et al., 2003). The reasons for improvement in the home and not in the behaviour clinic may be that the dog's fear abated only in the environment in which he or she was trained, i.e. in the owner's home (Miller, 1960). It is possible that simply changing the context in which the fearful stimuli is presented (i.e. the behaviour clinic) could reinstate the original fear response (Schwartz and Robbins, 1995). It seems unlikely that the subjects had simply become desensitized to the recording used in the training given their apparent improvement to real events, but this hypothesis cannot be excluded without more objective data on the response to the live event given recent findings about how dogs discriminate some live sounds from their recording (Fukuzawa et al., 2005). Based on the above findings it does not appear useful to play the CD in the behaviour clinic for follow-up sessions as a means to monitor therapeutic progress, but an initial assessment using a CD may be useful as it may give an accurate prediction of response to the recording in the home and is unlikely to give false positives of the real response.

#### 4.2. *Training progress and owner compliance*

Thirty-three percent of owners did not complete the training period. The drop out rate was higher for the FOF programme than for the SS programme (37% versus 20%); however, the most common reason given for dropping out for both programmes was a lack of time. Owner compliance is essential if a behavioural programme for noise fears is to be effective. The high drop out rate in this particular study is concerning as this was a highly motivated group of self-selected individuals. In addition, those who did complete the official 60-day training period were given the option to continue playing the recording prior to the next follow-up interview, but only 34% of the participants did. This raises the concern that the average dog owner who purchases a self-help firework CD programme for a "quick-fix" may be unlikely to complete the entire programme. Perhaps owner compliance would be increased if the owners could be informed of a minimum "time period" for which they should commit to the training that will maximize the chances of seeing behavioural improvement in their dog. Based on current findings a minimum of 60 days should be recommended.

Perhaps one of the most interesting aspects of lack of owner compliance during the training period relates to the instructions on how to use the CD recording itself. It is clearly written in both sets of instructional booklets that the CD should be played at a level in which no anxious and or fear-related behaviours are exhibited. It is clear from the early total severity scores (Fig. 4a) that the CDs were being played at levels which did elicit fear or anxiety related behaviours. Despite this lack of compliance, all dogs clearly showed a reduction in the severity of behaviours in response to the CD at the end of the first and second month of training. This finding is important both clinically and theoretically as the literature varies with recommendations on how to

implement noise desensitization and counter-conditioning programmes. Some advocate eliciting no fear-related behaviours (Tuber et al., 1982; Landsberg et al., 2003) whereas others recognize that a treatment option may include letting an animal who is showing signs of mild anxiety habituate to that level of volume (Voith and Borchelt, 1996). The authors would like to emphasize that eliciting fearful behaviours is not being advocated here but rather recognize the potential practical value of allowing a mild response so owners are aware of a change during training. Telling owners that no anxious signs should be elicited at any point may lead people to abandon a potentially useful treatment programme due to lack of perceived benefit or change during training. Two dogs were removed from this study as they showed no response to the CD recording at any volume level either in the clinic or in the home. To date there has been no study examining the general effect of playing recordings at a sub-responder level on clinical behaviour problems in dogs. Ideally guidelines on desensitization programmes should distinguish between behaviours that indicate fear versus those that indicate a dog that may be becoming slightly anxious; however there are several difficulties in accomplishing this. Firstly, the distinction between behaviours which indicate fears versus anxiety may not be very clear as many of the signs (e.g. panting) may indicate either fear or anxiety but differ in their intensity. Furthermore, not all dogs will exhibit anxiety in the same manner (Mills et al., 2006). Secondly, a dog that shows signs of low level anxiety, may or may not be amenable to counter-conditioning which is also an important component of the treatment plan. Even when a very low level of volume is played on a stereo, not all dogs may be able to exhibit manageable levels of anxiety let alone no anxiety at all, as indicated by one participant in the present study. By week 4, Dog X which had been in the SS treatment group had become sensitized and was generalizing the fear. This dog was given personalized behavioural advice including administration of psychopharmacological medication which was not administered until after the study due to the owner's reluctance to use medication. After implementing anxiolytic therapy, the owner reported a reduction in the dog's fear to real firework exposures.

Despite some lack of compliance, the majority of owners reported that they read the majority of the instruction booklet that accompanied the CDs with more people completing the reading of the instruction booklet that accompanied the FOF CD; however, at the end of the study 12% participating in the FOF programme stated implementation of the programme was difficult whereas, no one reported that the SS programme was difficult to implement. This discrepancy may be due to the nature of the instruction booklets that accompanied the CD. The FOF booklet was much shorter with less background information on noise fears and less detailed instructions on how to use the CD, e.g. "Reward your pet for remaining calm and relaxed while the CD is playing. You can use food treats, but also don't forget to talk to them and make a fuss as well" compared to the SS instruction booklet, e.g. "... play the tape at a very low level while your dog is doing something he really enjoys, such as eating or playing. With the CD set at the lowest volume level to give signs of recognition ... you should switch the player on. As soon as you begin to hear noises you should put the food down for your dog, or start the game. If he continues to eat or play you should leave the CD playing, but remember if he reacts to the noise you have proceeded too quickly. As soon as your dog finishes eating or playing the CD must be switched off immediately." Given that no one considered the SS programme difficult to implement and that there was a significant change with respect to global scores in the first follow-up, neither of which occurred for the FOF CD, perhaps the way in which the instructions are written is just as important if not more important than the actual quality or format of the recording itself or the sound equipment on which the recording is played. Supporting the latter hypotheses is the fact that there were no differences in the total severity scores between CD programme despite obvious audible differences in quality of recordings and in the way in which the noises were formatted

(e.g. random versus graded intensities). In addition, the two dogs who did not respond fearfully to one firework CD, did not respond to any of the three CDs involved in this study. Both of these dogs heard at least two of the CDs on different qualities of stereo equipment and in different environments (home and the behaviour clinic). Despite the differences in the recording themselves, both CDs elicited a similar group of fear behaviours in over 50% of the dogs. These behaviours included hiding, cowering, panting, owner seeking, and vigilance which are amongst five of the most commonly occurring behaviours to real firework exposures.

It is worth noting that all of the behaviours that significantly improved in response to the CD recording showed significant improvement in response to real exposures. There were some behaviours (i.e. freezing and pacing) that did not show significant improvement to the CD recording but did improve during real exposures.

One must take into consideration that whilst behaviourists in practice routinely judge the efficacy of behavioural programmes on owner reports, this method of assessment has not been validated with respect to firework fears in dogs. Therefore, although it appears that these self-help programmes can reduce fear-related behaviours of dogs to firework noises; it is possible that owners may not be reporting the behavioural changes accurately. Videotaping dogs' responses to firework recordings in the home before and after treatment remains the ideal method to measure objectively the efficacy of such programmes.

## 5. Conclusions

Self-help desensitization and counter-conditioning programmes for firework fears in combination with the use of DAP appear to be a potentially effective way of reducing owner reported fear-related behaviours in dogs, but compliance may be expected to be poor. If owners apply the treatment for 60 days an overall reduction of approximately 60% in the number of signs exhibited may be expected on average but this depends on the specific signs being shown. Most signs, even if they are not eliminated, appear to decrease in their severity. This appears satisfactory to the majority of owners.

It appears that the clarity of the instructions is critical for clients to perceive the programme as easy to implement. Given the variation in the sound systems used by owners, the recording quality of the CD does not, in this study, appear to be such an important factor in the success of therapy. All programmes should carry a clear warning about the role of sensitization, with a recommendation to stop treatment and seek specialist veterinary attention if this should occur, in order to safeguard the welfare of animals being treated.

## Acknowledgements

The authors would like to thank both the Fear of Fireworks and Sounds Scary companies for providing the CD programmes free of charge. The authors would also like to thank CEVA for providing the Dog Appeasing Pheromone free of charge.

## References

- Beaver, B., 1999. Canine behavior of sensory and neural origin. In: Beaver, B. (Ed.), *Canine Behavior: A Guide for Veterinarians*. WB Saunders Co., Philadelphia, USA, pp. 43–105.
- Crowell-Davis, S., Seibert, L.M., Sung, W., Parthasarathy, V., Curtis, T.M., 2003. Use of clomipramine, alprazolam, and behavior modification for treatment of storm phobia in dogs. *J. Am. Vet. Med. Assoc.* 222, 744–749.

- Fukuzawa, M., Mills, D., Cooper, J.J., 2005. More than just a word: non-semantic command variables affect obedience in the domestic dog (*Canis familiaris*). *Appl. Anim. Behav. Sci.* 91, 129–141.
- Hothersall, D., Tuber, D., 1979. Fears in companion dogs: characteristics and treatment. In: Keehn, J.D. (Ed.), *Psychopathology in Animals: Research and Clinical Implications*. Academic Press, New York, USA, pp. 239–255.
- Landsberg, G., Hunthausen, W., Ackerman, L., 2003. Fears and phobias. In: *Handbook of Behavior Problems of the Dog and Cat*, 2nd ed. Saunders, Toronto, Canada, pp. 227–268.
- Longford, N.T., Ely, M., Hardy, R., Wadsworth, M.E., 2000. Handling missing data in diaries of alcohol consumption. *J. Roy. Stat. Soc.: Ser. A* 163, 381–402.
- Martin, P., Bateson, B., 1993. *Measuring Behaviour*. Cambridge University Press, UK.
- Miller, N.E., 1960. Learning resistance to pain and fear: effects of overlearning, exposure, and rewarded exposure in context. *J. Exp. Psychol.* 60, 137–145.
- Mills, D., Gandia Estelles, M., Cleshaw, P.H., Shorthouse, C., 2003. Retrospective analysis of the treatment of firework fears in dogs. *Vet. Rec.* 153, 561–562.
- Mills, D.S., Ramos, D., Gandia Estelles, M., Hargrave, C., 2006. A triple blind placebo controlled investigation into the assessment of the effect of Dog Appeasing Pheromone (DAP) on anxiety related behaviour of problem dogs in the veterinary clinic. *Appl. Anim. Behav. Sci.* 98, 114–126.
- Overall, K.L., 1997. Fear, anxieties, and stereotypes. In: *Clinical Behavioral Medicine For Small Animals*, 1st ed. Mosby, St. Louis, Missouri, pp. 209–250.
- Overall, K.L., 2002. Noise phobias in dogs. In: Horwitz, D., Mills, D., Heath, S. (Eds.), *BSAVA Manual of Canine and Feline Behavioural Medicine*. BSAVA, Gloucester, UK, pp. 164–172.
- Schwartz, B., Robbins, S., 1995. *Psychology of Learning and Behavior*, 4th ed. Norton & Company, New York.
- Sheppard, G., Mills, D., 2003. Evaluation of dog-appeasing pheromone as a potential treatment for dogs fearful of fireworks. *Vet. Rec.* 152, 432–436.
- Shull-Selcer, E., Stagg, W., 1991. Advances in the understanding and treatment of noise phobias. In: Marder, A.R., Voith, V.L. (Eds.), *Vet. Clin. North Am. [Small Anim. Pract.]* 21 (2), 353–367.
- Tuber, D.S., Hothersall, D., Peters, M.F., 1982. Treatment of fears and phobias in dogs. In: Voith, V., Borchelt, P. (Eds.), *Vet. Clin. North Am. [Small Anim. Pract.]* 12, 607–623.
- Voith, V., Borchelt, P., 1996. Fears and phobias in companion animals. In: *Readings in Companion Animal Behavior*, Veterinary Learning Systems, Trenton, New Jersey, pp. 140–153.