Study into the use and efficacy of Pet Remedy in the support of the Training and Behavioural Modification of Dogs

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Overview and Background

I was delighted to be asked to look over two studies carried out by the Animal Behaviour Centre, into the use and efficacy of Pet Remedy in the support of the Training and Behavioural Modification of Dogs. This included looking at the data that was independently examined and verfiied by Select Statistical Services. As well as looking at the study data, I also spoke with Christina Meaney who conducted both studies, to gain further insight into their background and learnt of extra interesting anecdotal findings whilst they were being conducted.

I wanted to bring both of these studies together, as combined they have created a large-scale study of real word dogs working through behavioural challenges. Many training and behaviour colleagues have found best outcomes are often to be found through a combination of the use of products such as Pet Remedy and training protocols, and these two studies have been designed to test this out.

Through interviewing those involved in the study, I have learnt of important background information which I feel is worthy of mention here. The study director, Christina Meaney, undertook the first study (2013) to decide for herself if the Pet Remedy product was worthy of her attention and support. When I discussed this with Christina, she admitted she came to the study from a place of uncertainty and caution, having previously found other calming products to have been ineffective. So, to have the first study undertaken by someone independent of the brand, with a sole view of examining its efficacy, is unusual and really adds to the 'real world' aspect of these studies.

Building on that 'real world' aspect, both studies used cases of dogs that had moderate to severe behavioural challenges, and followed their training journey, with their owners, over 3 months. I feel this is an important component of the studies. These were a wide mix of dogs with a variety of challenges, being supported through various training protocols with their owners, all reflecting the working reality for most trainers and behavioural practitioners. I feel Christina and her team developed a very authentic way of testing if, along with training support, the use of Pet Remedy helped to support best outcomes for those owners and dogs.

The two studies had large numbers of study subjects – around 60 on each study. An extra strength to these studies is that whilst both shared the same data collection criteria, the two were formatted differently.

In the first study in 2013, the dogs were observed over 3 months with the dogs alternating between Placebo and Pet Remedy. So, for half the dogs this meant month 1 being placebo, month 2 Pet Remedy and the month 3 being back to Placebo. The opposite was true for the other half. This format was a wonderful way of assessing the efficacy of the product during that dogs training journey.

In the second study – 2014 – the same data collection criteria were used, again over 3 months, but this time the dogs were allocated either Pet Remedy or Placebo at the start of the 3 months, and stayed with that for the entirety of the study. This gave a more linear exploration of the potential efficacy of the product.

Taking both studies together, we have a large subject set of around 120 different dogs, all being assessed by the same criteria during their support programmes, but with two different outlooks on the use of, and efficacy of, the Pet Remedy product. The data clearly shows, from both studies, that

the results are consistent with Pet Remedy being an important support in the training and behavioural modification of the dogs studied.

Also, in support of the hard data, which will be presented in the rest of this document, the anecdotal feedback from the study was also outstanding. From my interview with those involved in the study, the following are worthy of note.

- On the first study, where owners were asked to switch at the end of month one, many who had the Pet Remedy (they did not know this was the product) in August and then asked to switch to Placebo, then requested to be switched back as they had noticed such a huge difference in their dogs when on the initial blend (Pet Remedy).
- Of the 60 owners, all but 4 were prepared to give positive testimonies about the use of the Pet Remedy blend on their dogs.
- Many owners on the Pet Remedy blend reported marked changes in their dogs within 24 hours
- 10 of the dogs in the first study (1 in 6) were observed to actively seek out the product and took every opportunity to either be close to where the plug ins were, or go to the mats that had been sprayed with the product.

Whilst it is always challenging with these types of study to directly attribute all the observed effects to the study treatment received in each month, the results are clearly consistent with Pet Remedy being an important support in the training and behavioural modification of the dogs studied. A reasonable conclusion can be taken that the addition of Pet Remedy not only aided in the training and behaviour modification process, but also reduced stress in the dogs during the study.

There has been extensive research into the role of stress in impairing the ability to learn *. These results may imply that the addition of Pet Remedy helped to relieve the dogs of acute stress and therefore supported more learning and retention of that learning.

In my conclusion, not only do these studies supply strong analytical data supporting the efficacy of the product in supporting training protocols, the evidence offered through the anecdotal feedback is also hugely supportive.

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Andrew is a Certified Animal Behaviourist working in the UK. Andrew has over 10 years' experience working in animal behaviour, predominately with dogs. He was the Chair, and then Trustee, of the Association of INTODogs, and was a driving force behind the UK Dog Behaviour and Training Charter. He works as an independent behaviour consultant for Pet Remedy, advising on animal behaviour, and helping in collating of data to support external, independent clinical studies.

* Dr. Justin B. Echouffo-Tcheugui et al. Circulating cortisol and cognitive and structural brain measures (2018)

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Study 1 – August to October 2013

Summary

In this three-month long study, 60 dogs with behavioural issues underwent a behavioural modification programme and alternately received Pet Remedy treatment and a placebo. Dogs on Pet Remedy in the first month were switched to placebo in the second month and then back to Pet Remedy in the final month, and vice-versa. The study data was undertaken independently by Animal Behaviour Centre, and that data was then collated separately by Select Statistical Services.

Whilst it is always challenging with this type of study to directly attribute all the observed effects to the study treatment received in each month, the results are consistent with Pet Remedy being an important support in the training and behavioural modification of the dog studied. A reasonable conclusion can be taken that the addition of Pet Remedy not only aided in the training and behaviour modification process, but also reduced stress in the dogs during the study.

Method

The study was performed by the Animal Behaviour Centre, under the direction of Christina Meaney. Christina is a Kennel Club accredited Instructor, KCAI as advanced levels in Companion Dog Training and The Kennel Club Good Citizens awards. Christine is also a KCAI assessor and kennel Club Judge; her previous roles have included that of KCAI Regional Mentor.

Sixty dogs were included in the study and these were of varying breeds, ages, genders, etc. Each dog had a behavioural issue on entry to the study and was put on a behavioural modification programme to try to improve their behaviour. At the beginning of the study, each dog was assessed to decide on what behavioural therapy was appropriate. It is important to note that as all of the dogs were on a behaviour modification program throughout the study, we would expect the dogs' behaviour to improve over time (with or without the Pet Remedy treatment). Therefore, the aim of the analysis is to show that behavioural therapy combined with the Pet Remedy treatment is associated with a larger improvement than behaviour therapy combined with the placebo.

Dogs were alternately assigned to receive the placebo or the Pet Remedy treatment in the first month of the study (August) on a sequential basis as they entered the trial. Dogs on Pet Remedy in August were switched to placebo in September and then back to Pet Remedy in October, and vice versa. Each month the dogs had multiple sessions where they received the placebo or Pet Remedy treatment, along with having other behavioural therapy with work being done by their owners at home. It is noted that during the study three dogs dropped-out due to being rehomed or put to sleep.

Data Collection

Three sets of outcome data were provided, corresponding to recordings made in August, September, and October. Two separate outcomes were recorded for each dog in each month: their excitement level (measured from 0-5, i.e., "not excited" to "very excited") and their behaviour score (measured from 0-5, i.e., "poor/unacceptable" to "better/good"). In each of the three months, the dogs had multiple sessions when they worked through four standard exercises ('hand feeding', 'positions from behind the dog', 'door manners', and 'stop on recall') plus additional dog-specific exercises. The outcome variables were only calculated at the end of each month of treatment before the dogs were switched to the next alternative therapy.

Two of the sixty dogs were assigned to placebo and Pet Remedy in all three of the study months, respectively (T38 and T39); their results were therefore entirely excluded from the analysis. It was noted that one dog did not have any results in August (T61) as their initial tests were not performed at the study site. Three dogs were put to sleep during the study; two of which therefore did not contribute any results in September and October (for T32 and T57), and one of which therefore did not contribute any results in September (T16). One dog was rehomed during the study and therefore did not contribute any results in October (T15 and T16, respectively). Two further behaviour scores were observed to be missing for September (T12 and T25).

It was noted that as no data were available on the baseline (pre-study intervention) behaviour scores and excitement levels for the dogs, it would not be appropriate to compare the August outcomes between the dogs receiving the Pet Remedy and the placebo in the first month. This would fail to take into account the baseline excitement level and behaviour score of the dogs when they entered the study.

Data Analysis

The Data from the study was passed on to Select Statistical Services, based in Exeter. www.select-statistics.co.uk.

Select were provided with data recordings of the behaviour scores and excitement levels of the dogs involved in the study. They were instructed to undertake the following tasks:

1. Read the data from the Excel sheets provided (Appendix 1)
2. Perform any necessary data processing, including calculation of the changes in the outcome variables (excitement levels and behaviour scores) between months.
3. Exploratory data analysis to visualise the results.
4. Perform Mann-Whitney U tests comparing the change in excitement level and behaviour score between months for dogs on Pet Remedy versus dogs on placebo in each follow-up month.

It is standard practice when undertaking a statistical analysis, to begin with some exploratory analyses. This helps us to summarise the main characteristics of the dataset and to explore whether there is any visual evidence of relationships between the variables.

Behaviour Scores

A boxplot of the behaviour scores by month is shown in Figure 1 (see the footnote below for an explanation of the statistics displayed in each boxplot1). There is a clear indication of an increase (i.e., improvement) in the behaviour scores, on average, from August to September and from September to October looking at all dogs, regardless of the treatment received in each month.

Summary statistics of the behaviour scores and changes in the behaviour scores by month and treatment are given in Table 1 and Table 2, respectively. The behaviour scores and changes in the behaviour scores by month and treatment are also visualised in the boxplots shown in Figure 2, Figure 3 and Figure 4. From August to September, there is no indication of a change in the behaviour scores, on average, for dogs on Pet Remedy then placebo in September. However, there is an apparent increase in the behaviour scores, on average, from August to September for dogs on placebo then Pet Remedy in September. From September to October, there is a decrease on average in the behaviour scores for dogs on placebo, Pet Remedy then placebo in October. In contrast, there is a large increase (median=3 point increase) on average in the behaviour scores between September and October for dogs on Pet Remedy, placebo then Pet Remedy in October.

Looking at the changes in the behaviour scores between August and October, there is a small increase in the behaviour scores on average for dogs on placebo, Pet Remedy then placebo in October (median=1 point increase). A larger increase was observed between August and October on average for dogs on Pet Remedy, placebo then Pet Remedy in October (median=2.75 point increase)

Excitement Levels

A boxplot of the excitement levels by month is shown in Figure 5. There is some indication of an increase (i.e., improvement) in the excitement levels, on average, from August to September and from September to October looking at all dogs, regardless of the treatment received in each month.

Summary statistics of the excitement levels and changes in the excitement levels by month and treatment are given in Table 3 and Table 4, respectively. The excitement levels and changes in the excitement levels by month and treatment are also visualised in the boxplots shown in Figure 6, Figure 7 and Figure 8. From August to September, there is no indication of a change in the excitement levels, on average, for dogs on Pet Remedy then placebo in September. However, there is an apparent increase in the excitement levels, on average, from August to September for dogs on placebo then Pet Remedy in September. From September to October, there is a decrease on average in the behaviour scores for dogs on placebo, Pet Remedy then placebo in October (median=- 1 point decrease). In contrast, there is a large increase (median=3 point increase) on average in the excitement levels for dogs on Pet Remedy, placebo then Pet Remedy in October.

Looking at the changes in the behaviour scores between August and October, there is a small increase in the excitement levels on average for dogs on placebo, Pet Remedy then placebo in October (median=1.5 point increase). A larger increase was observed between August and October on average for dogs on Pet Remedy, placebo then Pet Remedy in October (median=3 point increase).

It is important to acknowledge that, due to the design of the study, it is not possible to directly attribute the changes observed to the study treatment received in the current month in each case. As each dog was switched between placebo and Pet Remedy from month-to-month, it is not possible to rule out the possibility of so-called carryover or lagged effects of the treatments received in previous months

Hypothesis Testing

Mann-Whitney U tests were performed to compare the change in behaviour score and excitement level between months for dogs on Pet Remedy versus dogs on placebo in each follow-up month.

Behaviour Scores

Results of the Mann-Whitney U tests for the changes in the behaviour scores are given in Table 2

A highly statistically significant difference was observed in the average change in the behaviour scores between August and September for dogs on Pet remedy in August and placebo in September versus dogs on placebo in August and Pet Remedy in September (median change of 2 points versus zero points).

A highly statistically significant difference was also observed in the average change in the behaviour scores between September and October for dogs on placebo in August, Pet Remedy in September and placebo in October versus dogs on Pet remedy in August, placebo in September and Pet Remedy in October ($p< 0.0001$). Dogs on Pet Remedy in October saw an improvement in their behaviour score between September and October, on average, whereas dogs on placebo in October saw a small decrease on average (median change of 3 points versus -0.5 points).

Looking across the entire period of the trial, a highly statistically significant difference was also observed in the average change in the behaviour scores between August and October for dogs on placebo in August, Pet Remedy in September and placebo in October versus dogs on Pet remedy in August, placebo in September and Pet Remedy in October ($p< 0.0001$). Dogs on Pet Remedy in October saw a greater improvement in their behaviour score between August and October, on average, compared with dogs on placebo in October (median change of 2.75 points versus 1 point increase).

Excitement Levels

Results of the Mann-Whitney U tests for the changes in the excitement levels are given in Table 4.

A highly statistically significant difference was observed in the average change in the excitement levels between August and September for dogs on Pet remedy in August and placebo in September versus dogs on placebo in August and Pet Remedy in September ($p< 0.0001$). Dogs on Pet Remedy in September saw an improvement in their excitement level between August and September, on average, whereas no change was observed on average for dogs on placebo in September (median change of 2.5 points versus zero points).

A highly statistically significant difference was also observed in the average change in the excitement levels between September and October for dogs on placebo in August, Pet Remedy in September and placebo in October versus dogs on Pet remedy in August, placebo in September and Pet Remedy in October ($p< 0.0001$). Dogs on Pet Remedy in October saw an improvement in their excitement level between September and October, on average, whereas dogs on placebo in October saw a small decrease on average (median change of 3 points versus -1 points).

Looking across the entire period of the trial, a highly statistically significant difference was again observed in the average change in the excitement levels between August and October for dogs on placebo in August, Pet Remedy in September and placebo in October versus dogs on Pet remedy in August, placebo in September and Pet Remedy in October ($p< 0.0001$). Dogs on Pet Remedy in

October saw a greater improvement in their excitement level between August and October, on average, compared with dogs on placebo in October (median change of 3 points versus 1.5 point increase).

It should be reiterated that, due to the design of the study, it is not possible to directly attribute the changes observed in the trial to the study treatment received in the current follow-up month in each case. This is because of the possibility of so-called carryover or lagged effects of the treatments received in previous months.

Figures

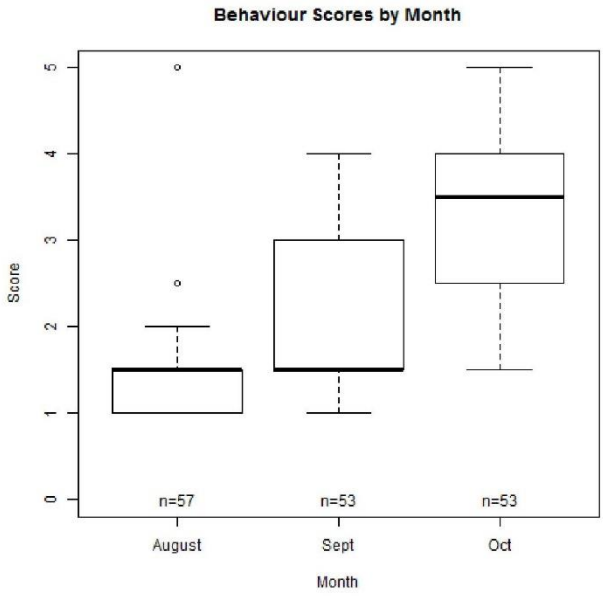


Figure 1: Boxplots of the behaviour scores by month.

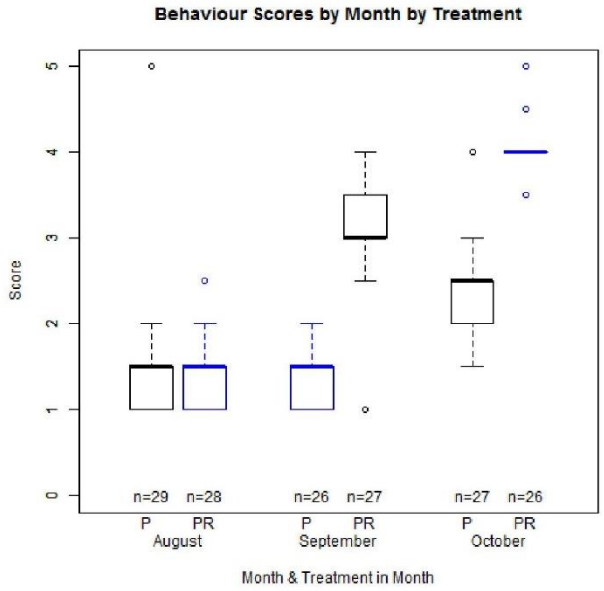
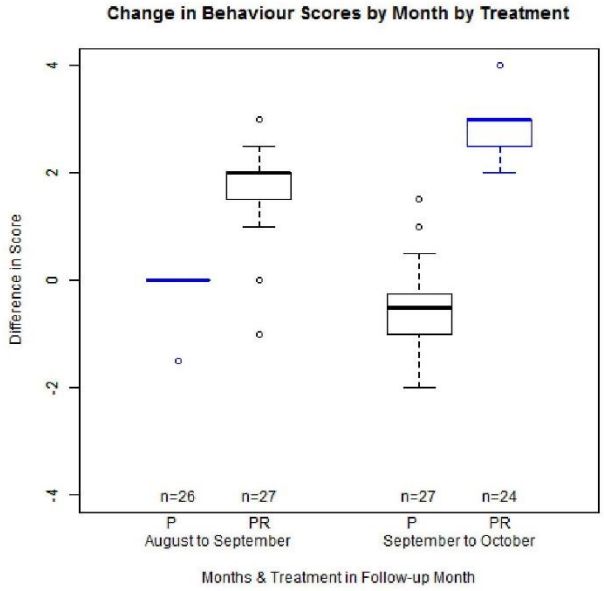


Figure 2: Boxplots of the behaviour scores by month by treatment in that month. P = placebo; PR = Pet Remedy. Note: dogs on placebo in August were switched to Pet Remedy in September and back to placebo in October, and vice-versa. Black = P, PR, P; Blue = PR, P, PR.



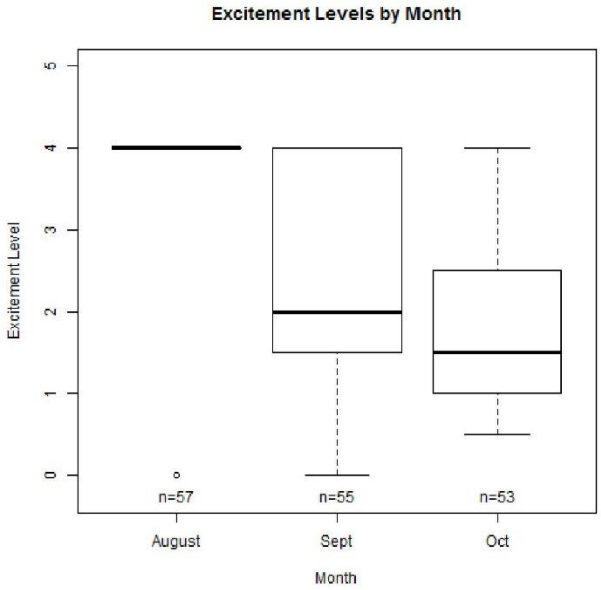


Figure 5: Boxplots of the excitement levels by month.

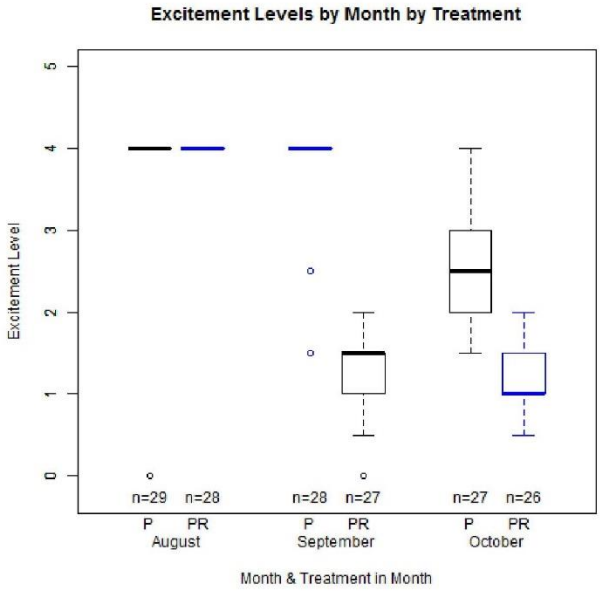


Figure 6: Boxplots of the excitement levels by month by treatment in that month. P = placebo; PR = Pet Remedy. Note: dogs on placebo in August were switched to Pet Remedy in September and back to placebo in October, and vice-versa. Black = P, PR, P; Blue = PR, P, PR.

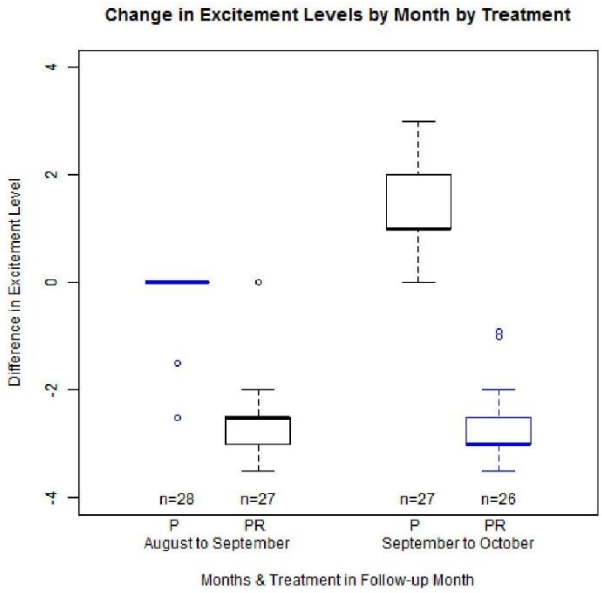


Figure 7: Boxplots of the differences in the excitement levels between August and September, and September and October by treatment in the follow-up month. P = placebo; PR = Pet Remedy. Note: dogs on placebo in August were switched to Pet Remedy in September and back to placebo in October, and vice-versa. Black = P, PR, P; Blue = PR, P, PR.

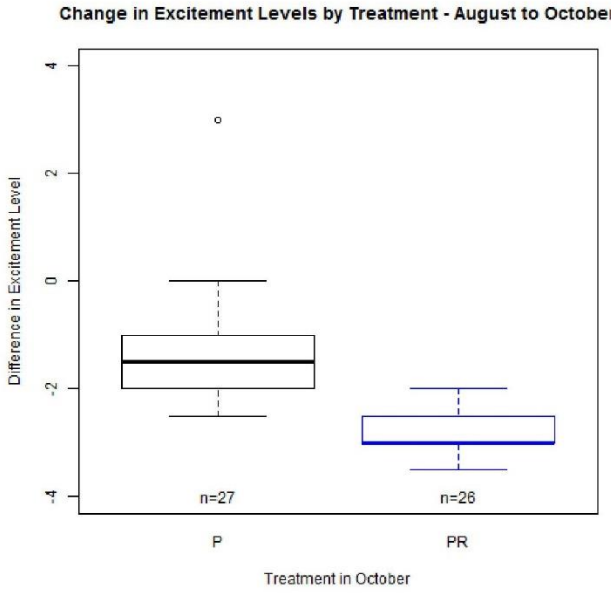


Figure 8: Boxplots of the differences in the excitement levels between August and October by treatment in the follow-up month. P = placebo; PR = Pet Remedy. Note: dogs on placebo in August were switched to Pet Remedy in September and back to placebo in October, and vice-versa. Black = P, PR, P; Blue = PR, P, PR.

Tables

Month	Treatment in Month	Median	Range	Mean	Standard Deviation
August	Placebo	1.5	1 – 5	1.41	0.745
	Pet Remedy	1.5	1 – 2.5	1.39	0.369
September	Placebo	1.5	1 – 2	1.33	0.281
	Pet Remedy	3.0	1 – 4	3.02	0.732
October	Placebo	2.5	1.5 – 4	2.39	0.525
	Pet Remedy	4.0	3.5 – 5	4.12	0.294

Table 1: Summary statistics for the behaviour scores by month by treatment in that month. Note: dogs on placebo in August were switched to Pet Remedy in September and back to placebo in October, and vice-versa.

Months	Treatment in Follow-up Month	Median	Range	Mean	SD	Estimated Difference	95% CI	p-value
August to September	Placebo	0	-1.5 – 0	-0.058	0.294	-2	(-2, -1.5)	<0.0001
	Pet Remedy	2	-1 – 3	1.61	0.847			
September to October	Placebo	-0.5	-2 – 1.5	-0.63	0.839	-3.5	(-3.5, -3)	<0.0001
	Pet Remedy	3	2 – 4	2.79	0.388			
August to October	Placebo	1	-2.5 – 3	0.98	0.925	-1.5	(-2, -1.5)	<0.0001
	Pet Remedy	2.75	1.5 – 4	2.73	0.452			

Table 2: Summary statistics for the change in behaviour scores between months by treatment in the follow-up month. SD = Standard Deviation. p-value is for a Mann-Whitney U test comparing the change in behaviour scores between months for dogs on placebo versus dogs on Pet Remedy in the follow-up month. A p-value of less than 0.05 is considered statistically significant at the commonly used 5% level. CI = Confidence Interval for the estimated difference between the changes in behaviour scores. Note: dogs on placebo in August were switched to Pet Remedy in September and back to placebo in October, and vice-versa.

Month	Treatment in Month	Median	Range	Mean	Standard Deviation
August	Placebo	4	0 – 4	3.86	0.743
	Pet Remedy	4	4 – 4	4.00	0
September	Placebo	4	1.5 – 4	3.80	0.598
	Pet Remedy	1.5	0 – 2	1.22	0.525
October	Placebo	2.5	1.5 – 4	2.54	0.553
	Pet Remedy	1	0.5 – 2	1.10	0.420

Table 3: Summary statistics for the excitement levels by month by treatment in that month. Note: dogs on placebo in August were switched to Pet Remedy in September and back to placebo in October, and vice-versa.

Months	Treatment in Follow-up Month	Median	Range	Mean	SD	Estimated Difference	95% CI	p-value
August to September	Placebo	0	-2.5 – 0	-0.20	0.598	2.5	(2.5, 3)	<0.0001
	Pet Remedy	-2.5	-3.5 – 0	-2.63	0.702			
September to October	Placebo	1	0 – 3	1.31	0.723	4	(3.5, 4.5)	<0.0001
	Pet Remedy	-3	-3.5 – -0.9	-2.69	0.745			
August to October	Placebo	-1.5	-2.5 – 3	-1.32	1.020	1.5	(1, 1.5)	<0.0001
	Pet Remedy	-3	-3.5 – -2	-2.90	0.420			

Table 4: Summary statistics for the change in excitement levels between months by treatment in the follow-up month. SD = Standard Deviation. p-value is for a Mann-Whitney U test comparing the change in excitement levels between months for dogs on placebo versus dogs on Pet Remedy in the follow-up month. A p-value of less than 0.05 is considered statistically significant at the commonly used 5% level. CI = Confidence Interval for the estimated difference between the changes in excitement levels. Note: dogs on placebo in August were switched to Pet Remedy in September and back to placebo in October, and vice-versa.

Conclusion Study 1

The results of this study are consistent with Pet Remedy being an effective support to training and behavioural modification in the dogs studied.

A general improvement in behaviour and increase in excitement levels across the three months was observed. Between the first and second months, there was strong evidence of a difference in the average change in the behaviour scores and excitement levels for dogs on Pet remedy versus placebo in the second month. The majority of dogs on Pet Remedy in the second month saw an improvement in their behaviour and excitement levels compared with no evidence of a change for dogs on placebo. A highly statistically significant difference was also observed between the second and third months, with dogs on Pet Remedy in the third month having an improvement and dogs on placebo in the third month having a small decrease in both their behaviour scores and excitement levels on average. Looking across the entire period of the trial, dogs on Pet Remedy in the final month saw a greater improvement in their behaviour scores and excitement levels between the first and final month, on average, compared with dogs on placebo in the final month.

Study 2 – January to April 2014

Summary

In this three-month long study, dogs with behavioural issues underwent a behavioural modification programme and received either Pet Remedy treatment or a placebo, by random assignment. The dogs remained on the same treatment throughout the study. The results of the final analysis of the study data are summarised below.

A general improvement in behaviour and decrease in excitement levels across the three months was observed. Highly statistically significant differences were observed between dogs on Pet Remedy and those on placebo. A greater improvement from baseline was seen for dogs on Pet Remedy compared with placebo after one, two and three months of follow-up, for both behaviour scores and excitement levels. The results are consistent with Pet Remedy being an effective treatment.

Method

The study was performed by the Animal Behaviour Centre, under the direction of Christina Meaney. Christina is a Kennel Club accredited Instructor, KCAI as advanced levels in Companion Dog Training and The Kennel Club Good Citizens awards. Christine is also a KCAI assessor and kennel Club Judge; her previous roles have included that of KCAI Regional Mentor.

Sample size calculations were performed to estimate the likely numbers of dogs that were needed in the study to be able to show a statistically significant difference between Pet Remedy and the placebo treatments (in combination with behavioural therapy) in improving the dogs' behaviour and excitement levels. Sixty-six dogs were recruited to the study and these were of varying breeds, ages, genders, etc. To avoid any issues with potential handler effects that could bias the study results, only one dog per handler was included in the study.

Each dog had a behavioural issue on entry to the study (e.g., nervous, aggressive, or anxious behaviour) and was put on a behavioural modification programme to try to improve their behaviour. At the beginning of the study, each dog was assessed to decide on what behavioural therapy was appropriate. The trial follows a so-called parallel group design. This is a simple, commonly used design which allows the comparison of the effectiveness of the two treatments: the "active treatment" – Pet Remedy in combination with behavioural therapy; and the "control treatment" – placebo with behavioural therapy. Dogs were alternately assigned to receive the placebo or the Pet Remedy treatment on a sequential basis as they entered the trial and continued to consistently receive this same treatment throughout the trial. This random assignment of treatment helps to ensure that we are making a fair comparison between the treatment groups by helping to protect against systematic differences between the groups at the start of the experiment.

Each month, there were multiple occasions where the dogs received the placebo or Pet Remedy treatment and attended sessions with the trainers at the Animal Behaviour Centre (with continued work being carried out by their owners at home). At each session, the dogs worked through various set-exercises (including, for example, hand feeding, and door manners) plus additional dog-specific exercises according to their behavioural therapy, as appropriate.

It is important to note that as all of the dogs were on a behaviour modification program throughout the study, we would expect the dogs' behaviour to have improved over time (with or without the Pet Remedy treatment). Therefore, the aim of the analysis is to show that behavioural therapy combined with the Pet Remedy treatment is associated with a larger improvement than behaviour therapy combined with the placebo.

In order to ensure that the results of the trial are as fair and accurate as possible, both the dog owners/handlers and trainers/assessors that marked and recorded the progress of the dogs were blinded to the treatment that each dog received during the trial. This means that the treatment information was withheld from both the dog owners/handlers and trainers/assessors. This is the "gold-standard" for a clinical trial and helps to ensure that, even subconsciously, dogs in the different treatment groups aren't handled differently, which could have a biasing effect on the results.

Data Collection

Two primary outcome variables are used to measure the progress of the dogs: a behaviour score; and an excitement level. Each of these outcomes constitutes a subjective assessment of the behaviour of the dogs and is measured as follows (with half-point scores permitted):

Behaviour score – measured on a scale from 0 to 5, representing "poor/unacceptable" to "normal/good" behaviour.

Excitement level – scored on a scale from 0 to 5, representing "not excited" to "very excited".

Assessments of the dogs' behaviour scores, excitement levels and incidences of excessive behaviour indicating stress were made both at the beginning of the study prior to any treatment being given, and were then recorded at monthly intervals from when the dogs commenced receiving behavioural therapy and Pet Remedy or placebo treatment. It is important that we take so-called baseline measurements so that we can assess the progress of the dogs compared to how they behaved at the start of the trial. This allows us to compare the within-dog changes between our treatment groups. It would not be appropriate to compare the raw outcome variables between the dogs receiving Pet Remedy and placebo as this would not take account of possible differences between the dogs' behaviour at the start of the study.

We were provided with data recording the behaviour scores, excitement levels and of the 66 dogs on the trial at baseline (January) and across the three months of follow-up (February, March and April). The data contained no missing values and no dogs were rehomed or put to sleep during the study.

In the following analysis we focus on the changes in behaviour scores and excitement levels observed and how these compared for the dogs on Pet Remedy versus placebo.

Data Analysis

The Data from the study was passed on to Select Statistical Services, based in Exeter. www.select-statistics.co.uk.

Select were provided with data recordings of the behaviour scores and excitement levels of the dogs involved in the study. They were instructed to undertake the following tasks:

1. Read the data from the Excel sheets provided (Appendix 2)
2. Perform any necessary data processing, including calculation of the changes in the outcome variables (excitement levels and behaviour scores) between months.
3. Exploratory data analysis to visualise the results.
4. Perform Mann-Whitney U tests comparing the change in excitement level and behaviour score between months for dogs on Pet Remedy versus dogs on placebo in each follow-up month.

It is standard practice when undertaking a statistical analysis to begin with some exploratory analyses. This helps us to summarise the main characteristics of the dataset and to explore whether there is any visual evidence of relationships between the variables.

Behaviour Scores

A boxplot of the behaviour scores by month is shown in Figure 1 (see the footnote below for an explanation of the statistics displayed in each boxplot1). There is a clear indication of an increase (i.e., improvement) in the behaviour scores, on average, from January (pre-treatment) to February (one month follow-up), from January to March (two month follow-up) and from January to April (three month follow-up) looking at all dogs, regardless of the treatment received.

Summary statistics of the behaviour scores and changes in behaviour score by month and treatment are given in Table 1 and Table 2, respectively. The behaviour scores and changes in behaviour score by month and treatment are also visualised in the boxplots shown in Figure 2 and Figure 3. There is an apparent increase in the behaviour scores, on average, from January (pre-treatment) to February for dogs on placebo and dogs on Pet Remedy. However, a larger increase was seen for Pet Remedy compared with placebo (median 1.5 versus 1 point increase), on average. From January to March, there was an increase on average in the behaviour scores for dogs on placebo and Pet Remedy, but with more dogs seeing greater improvement on Pet Remedy compared to placebo. Also, from January to April, there was an increase in behaviour scores on average for dogs on placebo and dogs on Pet Remedy, but with a larger increase for Pet Remedy compared with placebo (median 3 versus 2.5 point increase), on average.

Excitement Levels

A boxplot of the excitement levels by month is shown in Figure 4. There is some indication of a decrease (i.e., improvement) in the excitement levels, on average, from January (pre-treatment) to February (one month follow-up), from January to March (two month follow-up) and from January to April (three month follow-up) looking at all dogs, regardless of the treatment received.

Summary statistics of the excitement levels and changes in excitement level by month and treatment are given in Table 3 and Table 4, respectively. The excitement levels and changes in

excitement level by month and treatment are also visualised in the boxplots shown in Figure 5 and Figure 6. There is an apparent decrease in the excitement levels, on average, from January (pre treatment) to February for dogs on placebo and dogs on Pet Remedy. However, a larger decrease was seen for Pet Remedy compared with the placebo (median -1.5 versus -1 point decrease), on average. From January to March, there was a decrease on average in the excitement levels for dogs on placebo and Pet Remedy, but with more dogs seeing greater improvement on Pet Remedy compared to placebo. Also, from January to April, there was a decrease in excitement levels on average for dogs on placebo and dogs on Pet Remedy, but with a larger decrease for Pet Remedy compared with placebo (median- 3 versus -2.5 point decrease), on average.

Hypothesis Testing

Statistical tests were performed to compare the changes in behaviour score and excitement level between months for dogs on Pet Remedy versus dogs on placebo. As the outcome variables are scores (measured from 0 to 5) rather than continuous measurements, we use non-parametric Mann Whitney U tests in the analysis. This is a similar test to a commonly used independent t-test, which does not rely on the assumption of normally distributed data.

Behaviour Scores

Results of the Mann-Whitney U tests for the changes in behaviour score are given in Table 2.

A statistically significant difference was observed in the average change in behaviour score between January (pre-treatment) and February (one month follow-up) for dogs on Pet Remedy versus dogs on placebo (p=0.0011). Dogs on Pet Remedy had a greater improvement in their behaviour score, on average, than dogs on placebo after one month of follow-up (by an estimated half-point difference).

A statistically significant difference was also observed in the average change in behaviour score between January (pre-treatment) and March (two month follow-up) for dogs on placebo versus dogs on Pet Remedy (p=0.0070). Again, dogs on Pet Remedy had a greater improvement in their behaviour score, on average, than dogs on placebo after two months of follow-up (by an estimated half-point difference).

Similarly, a statistically significant difference was observed in the average change in behaviour score between January (pre-treatment) and April (three month follow-up) for dogs on placebo versus dogs on Pet Remedy (p=0.0047). Again, dogs on Pet Remedy had a greater improvement in their behaviour score, on average, than dogs on placebo after three months of follow-up (by an estimated half-point difference).

Excitement Levels

Results of the Mann-Whitney U tests for the changes in the excitement levels are given in Table 4.

A statistically significant difference was observed in the average change in excitement level between January and February for dogs on Pet Remedy versus dogs on placebo (p=0.0036). Dogs on Pet Remedy saw a greater improvement (decrease) in their excitement level, on average, than dogs on placebo after one month of follow-up (by an estimated half-point difference).

A statistically significant difference was also observed in the average change in excitement level between January and March for dogs on Pet Remedy versus dogs on placebo (p=0.0069). Dogs on

Pet Remedy saw a greater improvement (decrease) in their excitement level, on average, compared with dogs on placebo after two months of follow-up (by an estimated half-point difference).

Similarly, a statistically significant difference was observed in the average change in excitement level between January and April for dogs on Pet Remedy versus dogs on placebo ($p=0.0009$). Dogs on Pet Remedy saw a greater improvement (decrease) in their excitement level, on average, compared with dogs on placebo after three months of follow-up (by an estimated half-point difference).

Figures

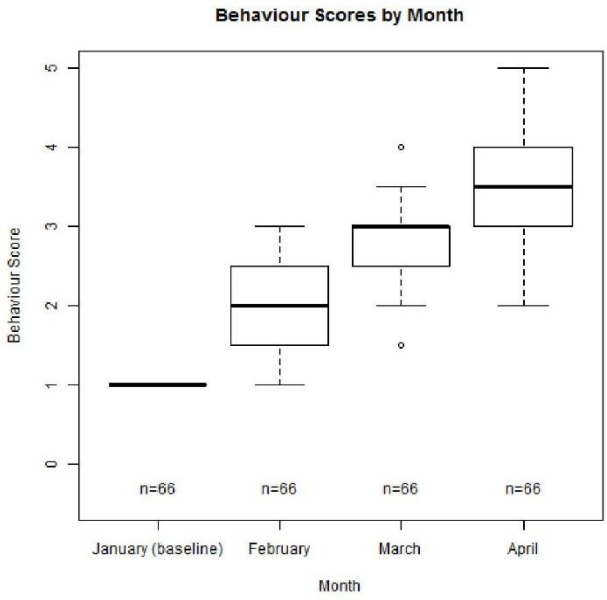


Figure 1: Boxplots of the behaviour scores by month.
Note: January scores are baseline (pre-treatment) results.

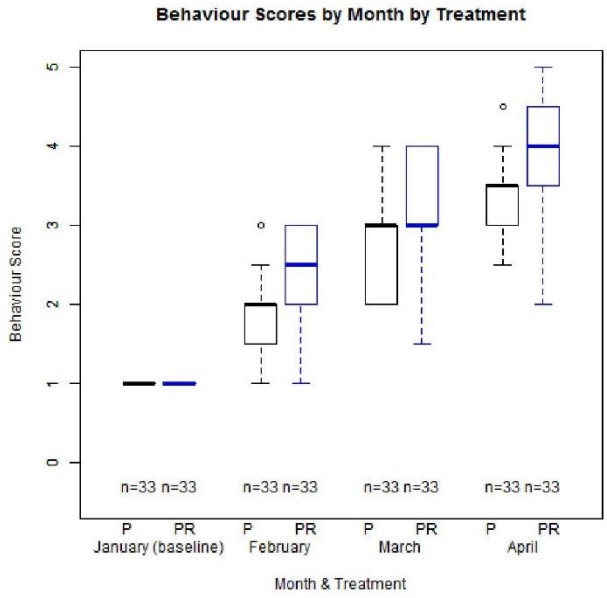


Figure 2: Boxplots of the behaviour scores by month by treatment. P = placebo (black); PR = Pet Remedy (blue).
Note: January scores are baseline (pre-treatment) results.

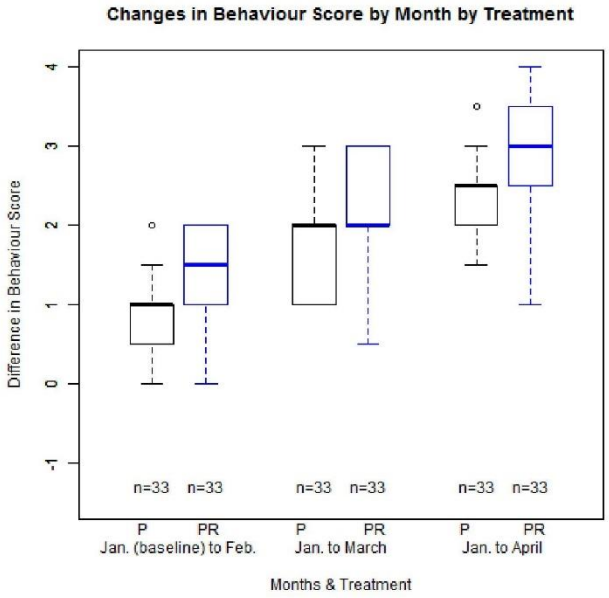


Figure 3: Boxplots of the differences in behaviour score between January (baseline) and February (one month follow-up), January and March (two month follow-up), and January and April (three month follow-up), by treatment. P = placebo (black); PR = Pet Remedy (blue).

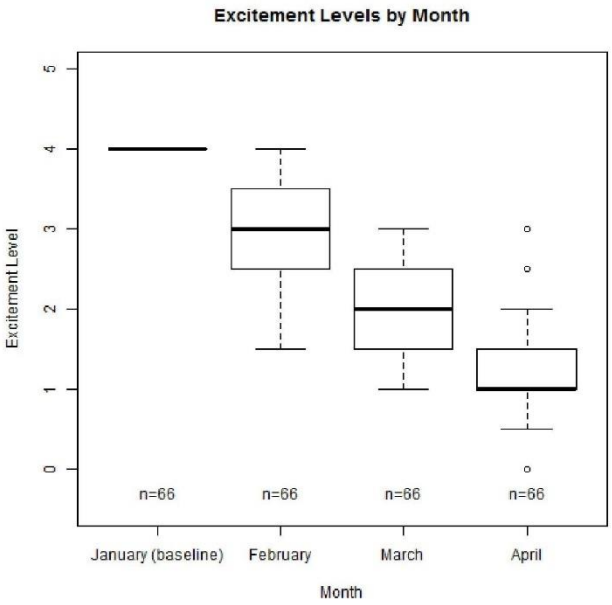


Figure 4: Boxplots of the excitement levels by month.
Note: January levels are baseline (pre-treatment) results.

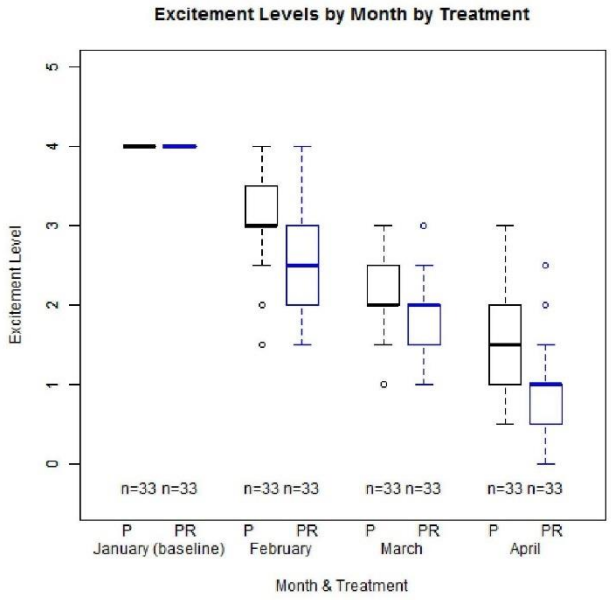


Figure 5: Boxplots of the excitement levels by month by treatment. P = placebo (black); PR = Pet Remedy (blue).
Note: January levels are baseline (pre-treatment) results.

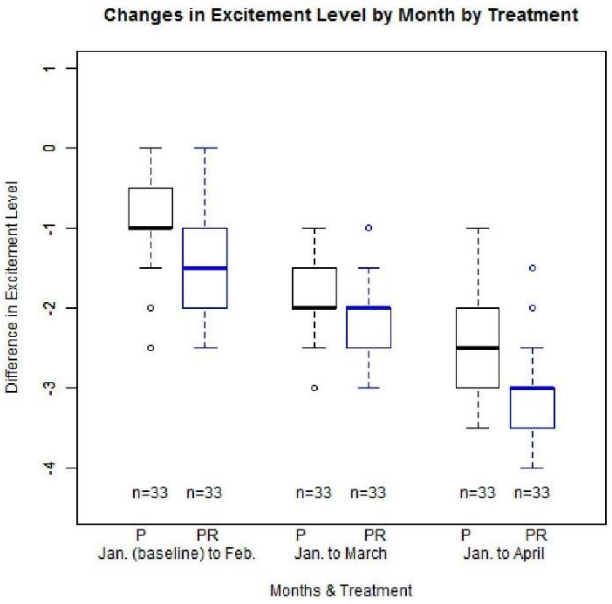


Figure 6: Boxplots of the differences in excitement level between January (baseline) and February (one month follow-up), January and March (two month follow-up), and January and April (three month follow-up), by treatment. P = placebo (black); PR = Pet Remedy (blue).

Month	Treatment	N	Median	Range	Mean	Standard Deviation
January (baseline)	Placebo	33	4	4 – 4	4	0
	Pet Remedy	33	4	4 – 4	4	0
February	Placebo	33	3	1.5 – 4	3.06	0.556
	Pet Remedy	33	2.5	1.5 – 4	2.63	0.628
March	Placebo	33	2	1 – 3	2.23	0.574
	Pet Remedy	33	2	1 – 3	1.85	0.606
April	Placebo	33	1.5	0.5 – 3	1.45	0.536
	Pet Remedy	33	1	0 – 2.5	1.02	0.579

Table 3: Summary statistics for the excitement levels by month by treatment.

Months	Treatment	N	Median	Range	Mean	SD	Estimated Difference	95% CI	p-value
January (baseline) to February	Placebo	33	-1	-2.5 – 0	-0.94	0.556	0.50	(0.0, 1.0)	0.0036
	Pet Remedy	33	-1.5	-2.5 – 0	-1.36	0.628			
January (baseline) to March	Placebo	33	-2	-3 – -1	-1.77	0.574	0.50	(0.0, 0.5)	0.0069
	Pet Remedy	33	-2	-3 – -1	-2.15	0.606			
January (baseline) to April	Placebo	33	-2.5	-3.5 – -1	-2.55	0.536	0.50	(0.0, 0.5)	0.0009
	Pet Remedy	33	-3	-4 – -1.5	-2.98	0.579			

Table 4: Summary statistics for the changes in excitement level between months by treatment. SD = Standard Deviation. p-value is for a Mann-Whitney U test comparing the changes in excitement level between months for dogs on placebo versus dogs on Pet Remedy. A p-value of less than 0.05 is considered statistically significant at the commonly used 5% level. CI = Confidence Interval for the estimated difference between the changes in excitement level. Estimated Difference = estimate of the difference in central tendency (median difference) between the two groups.

Tables

Month	Treatment	N	Median	Range	Mean	Standard Deviation
January (baseline)	Placebo	33	1	1 – 1	1	0
	Pet Remedy	33	1	1 – 1	1	0
February	Placebo	33	2	1 – 3	1.82	0.411
	Pet Remedy	33	2.5	1 – 3	2.27	0.663
March	Placebo	33	3	2 – 4	2.73	0.601
	Pet Remedy	33	3	1.5 – 4	3.15	0.701
April	Placebo	33	3.5	2.5 – 4.5	3.47	0.499
	Pet Remedy	33	4	2 – 5	3.85	0.690

Table 1: Summary statistics for the behaviour scores by month by treatment.

Months	Treatment	N	Median	Range	Mean	SD	Estimated Difference	95% CI	p-value
January (baseline) to February	Placebo	33	1	0 – 2	0.82	0.411	-0.50	(-1.0, 0.0)	0.0011
	Pet Remedy	33	1.5	0 – 2	1.27	0.663			
January (baseline) to March	Placebo	33	2	1 – 3	1.73	0.601	-0.50	(-1.0, 0.0)	0.0070
	Pet Remedy	33	2	0.5 – 3	2.15	0.701			
January (baseline) to April	Placebo	33	2.5	1.5 – 3.5	2.47	0.499	-0.50	(-1.0, 0.0)	0.0047
	Pet Remedy	33	3	1 – 4	2.85	0.690			

Table 2: Summary statistics for the changes in behaviour score between months by treatment. SD = Standard Deviation. p-value is for a Mann-Whitney U test comparing the changes in behaviour score between months for dogs on placebo versus dogs on Pet Remedy. A p-value of less than 0.05 is considered statistically significant at the commonly used 5% level. CI = Confidence Interval for the estimated difference between the changes in behaviour score. Estimated Difference = estimate of the difference in central tendency (median difference) between the treatment groups.

Conclusion Study 2

The results of this study are consistent with Pet Remedy being an effective support to training and behavioural modification in the dogs studied.

A general improvement in behaviour and decrease in excitement levels across the three months was observed. Highly statistically significant differences were observed between dogs on Pet Remedy and those on placebo. A greater improvement from baseline was seen for dogs on Pet Remedy compared with placebo after one, two and three months of follow-up, for both behaviour scores and excitement levels. So, the results are consistent with Pet Remedy being an effective treatment.