Study into the use and efficacy of Pet Remedy in support of training and behaviour modification in dogs

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Abstract

**Background to Research**

Many dog trainers and behavioural practitioners believe the use of Pet Remedy, in conjunction with training plans and protocols can contribute to best outcomes. This study has been designed to test that hypothesis.

**Methodology**

This independent study comprises 2 consecutive trials.

Both trials were conducted at the Animal Behaviour Centre in Northwich, under supervision of study director, Christina Meaney. Data from both trials was collated by Select Statistical Services in Exeter.

**Trial One** - 60 dogs with a variety of behavioural issues underwent a behavioural modification programme over 3 months during which they received alternately Pet Remedy treatment and placebo.

Dogs on Pet Remedy in the first month were switched to placebo in the second month and back to Pet Remedy in the final month, and vice-versa.

The dogs were real life cases, and their owners were supported by the training team.

**Trial Two** - 66 dogs with behavioural issues underwent a behavioural modification programme over 4 months and were given either Pet Remedy or placebo, by random assignment. The dogs received the same treatment throughout the study.

The dogs were real life cases, and their owners were supported by the training team.

**Conclusion**

Whilst always challenging with this type of study to attribute all observed effects to the treatment received, the results are clearly consistent with Pet Remedy being supportive in training and behavioural modification of the dogs studied. A reasonable conclusion can be drawn that the addition of Pet Remedy not only helped with training and behaviour modification, but also reduced stress in the dogs throughout the study.

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 each monthly follow-up, for both behaviour scores and excitement levels.

The study results support the hypothesis that using Pet Remedy in conjunction with training plans can help dogs become more receptive to support being offered.
Background & Hypothesis

Pet Remedy is used by many trainers and behavioural consultants as part of their behaviour modification protocols. It is used as a supportive product, and is perceived to help provide best outcomes in conjunction with training and behaviour support plans. This combination study was designed to test the hypothesis that using Pet Remedy in conjunction with training plans can help allow dogs be more receptive to the support being offered.

Study Overview

The study comprised of 2 trials completed by the Animal Behaviour Centre, into the use and efficacy of Pet Remedy in support of training and behaviour modification in dogs. Together, these trials create a large-scale study of real world dogs working through behavioural challenges. Many training and behaviour colleagues have found best outcome is often found through a combination of products such as Pet Remedy and training protocols. The study tests this hypothesis.

Building on the ‘real world’ aspect; both trials used dogs with moderate to severe behavioural challenges, and followed the training journey with their owners. This is an important part of the study design. There was a wide mix of dogs with a variety of challenges, being supported through various training protocols with their owners, and all reflecting the working reality for most trainers and behavioural practitioners.

The study director, Christina Meaney, undertook the study to determine if Pet Remedy was worthy of her attention and support. Christina admitted undertaking the study from a position of uncertainty and scepticism, having previously found other calming products ineffective.

The study comprises a large number of subjects, namely 60 dogs in trial 1 and 66 dogs in trial 2.

The purpose and strength of conducting 2 trials is that whilst sharing the same data collection criteria, the design format was different.

In trial 1, the dogs were observed over 3 months alternating between placebo and Pet Remedy. 50% of dogs were given placebo in month 1, Pet Remedy in month 2, and back to placebo in month 3. This sequence was reversed for the other 50%. This design format was helpful in assessing the efficacy of Pet Remedy during each dog’s training journey.

In trial 2, the same data collection criteria was used over 4 months. This time the dogs were allocated either Pet Remedy or placebo for the duration of the trial. This design format gave a more linear exploration of the potential efficacy of the product.

Data from each trial was independently examined and verified by Select Statistical Services.
When combined, the 2 trials comprise a large subject set of 126 dogs; all assessed by the same criteria throughout their support programmes; with two different outlooks on the use and efficacy of Pet Remedy.

The data from both trials are consistent with Pet Remedy being an important support mechanism in training and behavioural modification of the dogs studied.

In support of the hard data, the following anecdotal feedback from the dog owners involved in the study is worthy of note:

- In the first trial, a number of owners whose dog had Pet Remedy in month 1 and were then switched to placebo, requested to be switched back as they observed such an improvement in behaviour when using Pet Remedy.
- All but 4 owners were prepared to give positive testimonies about the use of Pet Remedy with their dogs.
- Many owners reported a marked improvement in their dogs within 24 hours of using Pet Remedy.
- 10 dogs (1 in 6) in trial 1 were observed to seek Pet Remedy and took every opportunity to be near the plug diffuser or go to the mats sprayed with Pet Remedy.

Whilst always challenging with this type of study to attribute all observed effects to the treatment received, the results are clearly consistent with Pet Remedy being supportive in training and behavioural modification of the dogs studied. A reasonable conclusion can be drawn that the addition of Pet Remedy not only helped with training and behaviour modification, but also reduced stress in the dogs throughout the study.

There has been extensive research into the role of stress impairing the ability to learn *. These results imply Pet Remedy helps relieve dogs of acute stress and therefore supports learning and retention.

In conclusion, the study provides strong analytical data to demonstrate the efficacy of Pet Remedy in supporting training protocols. The evidence offered through the anecdotal feedback is also supportive. It is therefore evident that Pet Remedy, when used in conjunction with good training protocols, can be an effective support mechanism and aid to best outcomes.

Andrew Hale BSc, ISCP.Dip.Canine.Prac, C.A.B


Trial One
August to October 2013

Method

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

60 dogs of varying breed, age, and gender, were included in the study. Each dog had a behavioural issue on entry to the study and was put on a behavioural modification programme. At the beginning of the study, each dog was assessed to determine an appropriate behavioural therapy. It is important to note that as all the dogs were on a behaviour modification program, we would expect behaviour to improve over time, with or without Pet Remedy treatment. Therefore, the aim of the study is to determine whether behavioural therapy combined with Pet Remedy results in a greater improvement than behaviour therapy combined with placebo.

Dogs were alternately assigned to receive placebo or Pet Remedy 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 placebo or Pet Remedy, along with other behavioural therapy and work undertaken with 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*; Blue = *PR*, *PR*.

**Figure 3:** Change in behaviour scores by month by treatment.
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; 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

<table>
<thead>
<tr>
<th>Month</th>
<th>Treatment in Month</th>
<th>Median</th>
<th>Range</th>
<th>Mean</th>
<th>Standard Deviation</th>
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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.

<table>
<thead>
<tr>
<th>Months</th>
<th>Treatment in Follow-up Month</th>
<th>Median</th>
<th>Range</th>
<th>Mean</th>
<th>SD</th>
<th>Estimated Difference</th>
<th>95% CI</th>
<th>p-value</th>
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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.

<table>
<thead>
<tr>
<th>Month</th>
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<th>Median</th>
<th>Range</th>
<th>Mean</th>
<th>Standard Deviation</th>
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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.

<table>
<thead>
<tr>
<th>Months</th>
<th>Treatment in Follow-up Month</th>
<th>Median</th>
<th>Range</th>
<th>Mean</th>
<th>SD</th>
<th>Estimated Difference</th>
<th>95% CI</th>
<th>p-value</th>
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<td>August to September</td>
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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

The results of this trial 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.
Trial Two

January to April 2014

Method

The trial 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. Christina 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 needed for the study to demonstrate a statistically significant difference between Pet Remedy and placebo in combination with behavioural therapy in improving the dogs’ behaviour and excitement levels.

66 dogs of varying breed, age, and gender, were recruited. 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. At the beginning of the study, each dog was assessed to determine an appropriate behavioural therapy.

The trial follows a so-called parallel group design. This is a simple, commonly used design which allows comparison of the effectiveness of two treatments:

“active treatment” (Pet Remedy in combination with behavioural therapy) v. “control treatment” (placebo in combination with behavioural therapy)

Dogs were alternately assigned to placebo or Pet Remedy on a sequential basis as they entered the trial and continued to receive this same treatment throughout the trial. This assignment of treatment helps ensure fair comparison between treatment groups by helping protect against systematic differences at the start of the trial.

Each month the dogs had multiple sessions where they received placebo or Pet Remedy, along with other behavioural therapy and work undertaken with their owners at home.

At each session, dogs worked through various set exercises (including hand feeding and door manners), plus additional dog-specific exercises appropriate to their behavioural therapy.

It is important to note that as all dogs were on a behaviour modification program throughout the trial, we would expect the dogs’ behaviour to improve over time with or without Pet Remedy treatment. Therefore, the aim of the study is to determine if behavioural therapy combined with Pet Remedy is associated with a greater improvement than behaviour therapy combined with placebo.
The dog owners/handlers and trainers/assessors that marked and recorded the dogs’ progress were blinded to the treatment each dog received. This means the treatment information was withheld. This is the “gold-standard” for a clinical trial and helps ensure, even subconsciously, dogs in different treatment groups are not handled differently, as this 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](http://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 boxplot). 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, compared with 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).
<table>
<thead>
<tr>
<th>Month</th>
<th>Treatment</th>
<th>N</th>
<th>Median</th>
<th>Range</th>
<th>Mean</th>
<th>Standard Deviation</th>
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<td>4</td>
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<tr>
<td></td>
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<td>4</td>
<td>4–4</td>
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<tr>
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<td>Placebo</td>
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Table 3: Summary statistics for the excitement levels by month by treatment.

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<tr>
<th>Months</th>
<th>Treatment</th>
<th>N</th>
<th>Median</th>
<th>Range</th>
<th>Mean</th>
<th>SD</th>
<th>Estimated Difference</th>
<th>95% CI</th>
<th>p-value</th>
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<td>(0.0, 0.5)</td>
<td>0.0069</td>
</tr>
<tr>
<td>January (baseline) to March</td>
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<td>0.50</td>
<td>(0.0, 0.5)</td>
<td>0.0009</td>
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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

<table>
<thead>
<tr>
<th>Month</th>
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<th>N</th>
<th>Median</th>
<th>Range</th>
<th>Mean</th>
<th>Standard Deviation</th>
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<tbody>
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<td>1–1</td>
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<tr>
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<td>1–1</td>
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<td>0</td>
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<td>0.411</td>
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<td>0.690</td>
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Table 1: Summary statistics for the behaviour scores by month by treatment.

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<th>Months</th>
<th>Treatment</th>
<th>N</th>
<th>Median</th>
<th>Range</th>
<th>Mean</th>
<th>SD</th>
<th>Estimated Difference</th>
<th>95% CI</th>
<th>p-value</th>
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<tbody>
<tr>
<td>January (baseline) to February</td>
<td>Placebo</td>
<td>33</td>
<td>1</td>
<td>0–2</td>
<td>0.82</td>
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<td>Pet Remedy</td>
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<td>January (baseline) to March</td>
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<td>2</td>
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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 two treatment groups.
Conclusion

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

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