No, I'm Not Electrocuting My Cats!

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No, I'm Not Electrocuting My Cats:
Treating Aggression and Anxiety with Cranial Electrotherapy Stimulation

Abstract

Due to Otto's over-excitement and Bailey's stress, I decided to base my project on my two cats. I decided to follow Bailey around for fifteen minutes a day to watch her body language and try to find her mood. I started my project by finding baseline observations to operationally define normal behaviour. I then moved on to the "sham treatment" phase, in which the cats were in the modified cat carrier without treatment. I did this to help design the box to give optimal treatment and to see what stress really was. After this was causing too much stress, I moved onto actual treatment. The Alpha-Stim 100 unit provided cranial electrotherapy stimulation, which is the electrical stimulation of the brain to treat anxiety, depression and insomnia. I began with earclips and handheld probes. I did not get very much treatment out of those, as the cats did not like being held in place while I touched something to their heads. I decided to try a revised treatment using a modified cat carrier. Electrical stimulation was provided through the cats' paws instead. To increase conductivity, I also put some electrode gel on the paws of the cats. This phase provided the results I was looking for from the beginning of the project, which were spectacular. Otto began to let us hold him longer throughout the day, as well as during formal observations, and was more friendly and calm towards Bailey after treatment. Bailey startled less after treatment, and did positive things she never did before, including climbing onto my sister Colleen's lap and taking part in mutual grooming with Otto for the first time. The results were so amazing that I plan on continuing treatment far beyond the end of the project.

Purpose:

The purpose of my investigation is to prove whether cranial electrotherapy stimulation will create similar stress and anxiety lowering effects on cats as it did on humans. Another part to the purpose of my experiment is to hopefully help my cats, Bailey and Otto, both of whom could do with a little calming down. Otto can be very hyper and playful, as well as bite rather hard. Bailey, on the other hand, can be very anxious and stressed out, especially when Otto is near and loud noises can be heard.

Question:

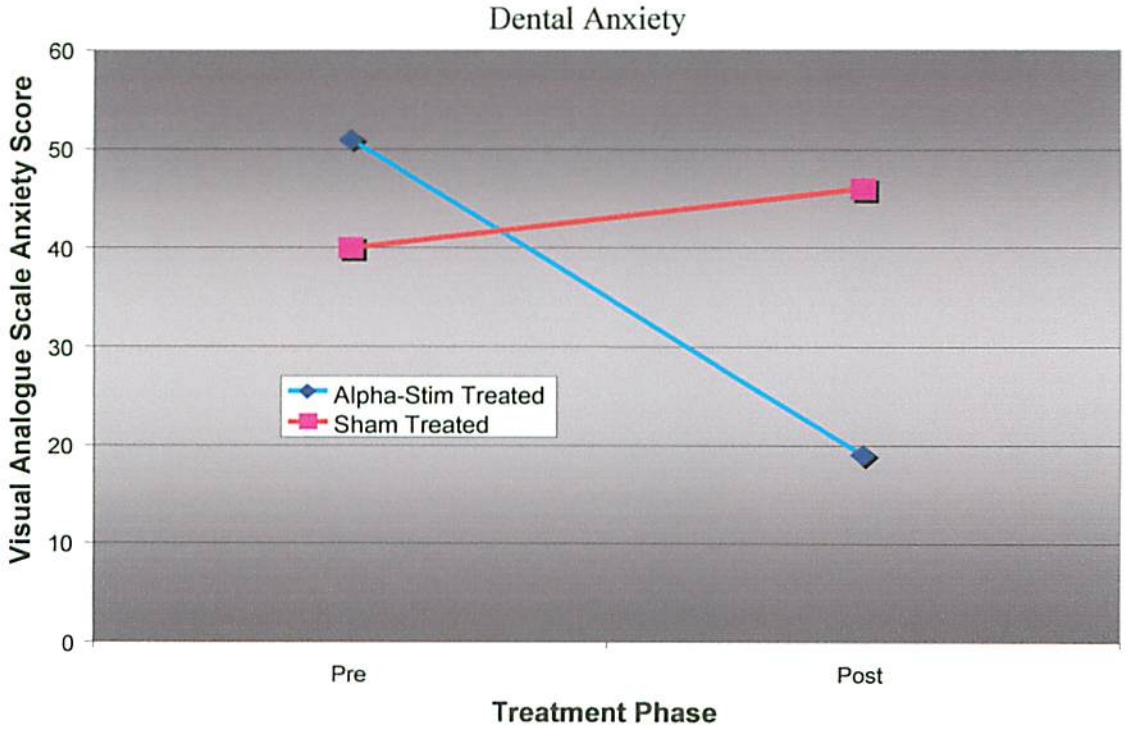
Will cranial electrotherapy stimulation create similar positive effects on cats as it did to humans?

Background:

Cranial electrotherapy stimulation provides a minimal electric current to the brain. It operates by treating the brain to lower symptoms related to the brain (stress, anxiety, insomnia etc.), or to areas that ache to reduce pain. It is handheld and designed for home

use. To prevent tissue damage, the voltage constantly switches from positive to negative. To truly comprehend how low the amperage is, one should think of treatment as music. The voltage would be notes, and the amperage would be the volume control. Even though the music is playing, the volume would be turned down so low that the user couldn't hear it!

CES is not an understudied thing, even in animals. This large amount of research has said that the CES unit can treat insomnia, depression, and anxiety [FDA (Food and Drug Administration) approved], but some experiments have shown that it may be able to treat pain, headaches, fibromyalgia and ADHD. The diagram below shows the increase in dental anxiety with sham treatment. It shows a massive decrease in anxiety with the Alpha-Stim unit.

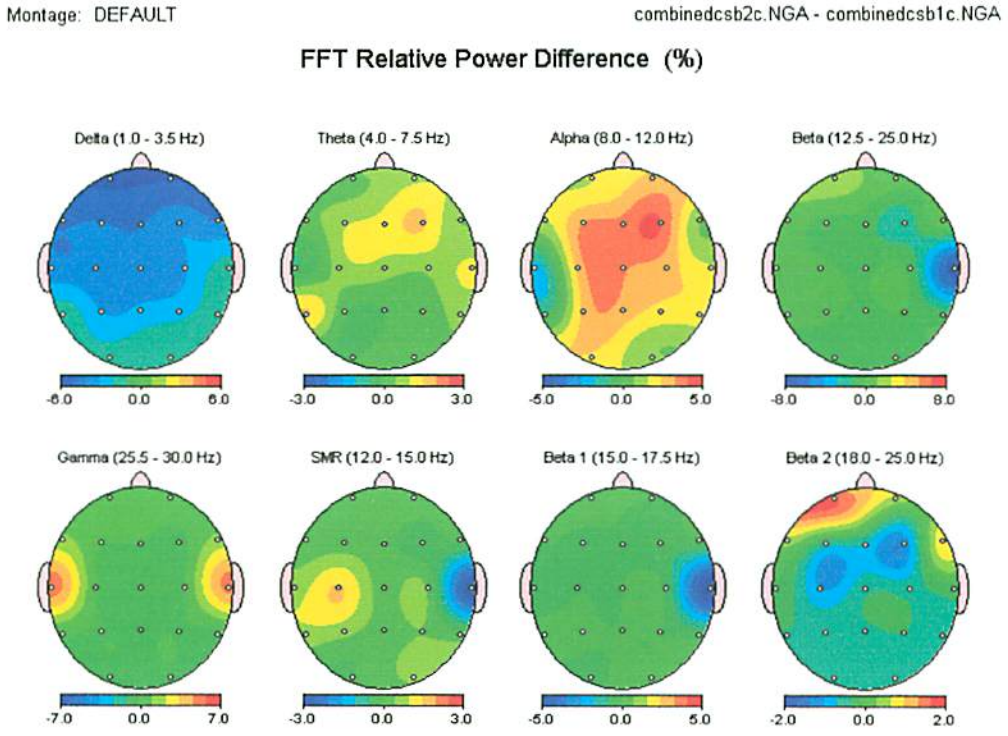


Although CES units are available only by prescription in the United States, they can be purchased by anyone in Canada. However, in Canada, they can't be advertised for the treatment of depression or anxiety. Health Canada regulations prevent any devices from being advertised as treatments for those disorders, no matter what the research about them says.

Treatment with a CES device usually consists of 20 to 60 minutes daily for three weeks, then every once in a while after that, as the effects are cumulative. The majority of patients have said that their anxiety symptoms had decreased after their first couple sessions. However, depression of the utmost severity could require as much as three weeks to receive results. During stimulation, users often encounter relaxed mental states and loose muscles, yet retain an advanced alertness. A prickly sensation or a slight pulsing feeling in the ear lobes are normal while using a CES unit. These feelings can be

a sign that you have the unit turned up too high, as high levels of current are not required. Double-blind studies prove that it works when even if you can't feel it.

Though we know that the CES creates positive effects, those who have researched it do not know how the electrical stimulation actually helps. These same researchers hypothesize that it could help brain chemistry and influence the way nerves communicate with each other. Research at the University of North Texas used QEEG (a measure of the electrical activity of the brain) to prove that CES did help to influence the electrical activity of the brain, using it as well as testing out the placebo effect. The picture below describes the changes in brain waves after using CES. The picture shows that delta waves went down and alpha waves increased.

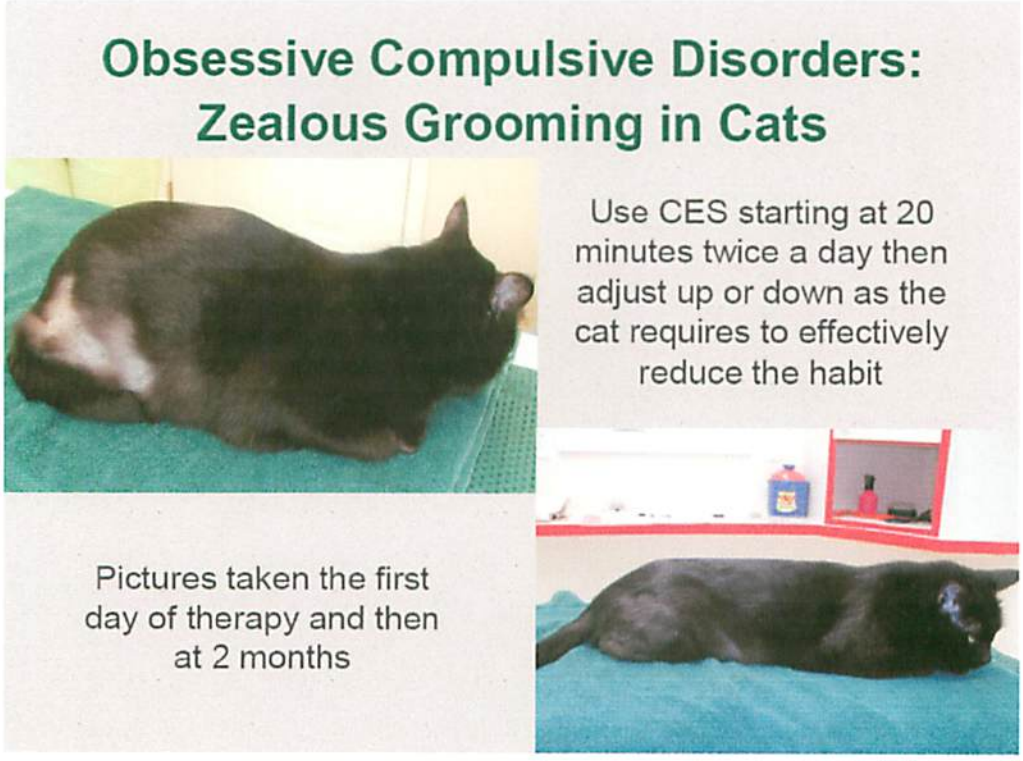


For his book, The Science Behind Cranial Electrotherapy Stimulation, Dr. Daniel L. Kirsch looked at all the CES research coming out of the past forty years and found one hundred twenty-six studies on humans, twenty-nine on animals, and thirty-one review articles. 89% of these studies came out with positive results.

The CES has minimal side effects and is very safe, as well as working well with all age groups. The occasional patient will have a short headache, slight dizziness or irritated skin produced by the electrodes. Even rarer side effects include excitement, anxiety, trouble sleeping, or increases in depression already existing. None of these side effects were severe, and the side effects are very mild and small in number in comparison to psychiatric medications.

CES has been used in cats. Dr. Daniel Kirsch provided us with the Alpha-Stim company's veterinary brochure, along with a picture of his own cat wearing the CES earclips! He also provided us with slides that he uses in a presentation, including one showing the beneficial effects of CES in a cat that was over-grooming itself.

Dr. Kirsch's cat, Kali, doesn't mind earclips. Our cats did!



The aim of my experiment was to create a change in my cats' emotional state. However, finding and pinpointing these changes would be very difficult, because what is an emotional change in a cat? Any cat owner will tell you that they can tell the way their feline friend is feeling, but to do so scientifically is a completely different story.

I based my experiment on one that was completed on horses. Clarke, Mills, and Marchant (2000) studied stress in race horses. They defined the tension through heart rate, body motion, head motion, ear position, oral behaviour and state of the lower lip. They used CES on the horses, and they found that after treatment, the horses spent more time dozing, less time with their lower lip tense, their heads wobbled more (a sign of dozing), they spent less time vocalizing and less time shaking their head. They also used some physiological measures, such as heart rate. They concluded that "[a]ll of these changes… strongly indicated a reduction in the horses' state of arousal following treatment but not sham treatment with Alpha-Stim CES."

In the horse experiment, they studied horse stress, but they used an "operational definition" of stress. An operational definition takes a crude idea and turns it into something that one can observe. In my study, I decided what behaviours in the cats might represent tension.

Hypothesis:

I believe that Bailey will be less stressed after the cranial electrotherapy stimulation treatment, and that Otto will become calmer.

Material List:

1 Alpha Stim 100 CES (cranial electrotherapy stimulation) unit
1 pair of CES electrodes
1 pair of CES ear clips
1 pair of CES probes
Alpha-Stim conducting fluid
Electrode gel
2 sheets of tin-foil (48x12 cm)
3 wooden blocks (1 2x4x48 cm, 2 4x4x48 cm)
1 half 6cm ABS pipe, 48 cm long
1 Cat carrier (50x29x34 cm)
2 pieces of Styrofoam (6x15x26 cm)
2 sheets of metal (18x48 cm)
4 nuts and bolts
Duct Tape
Silicone glue
1 Heating pad
1 Stopwatch
Behaviour Charts

Subjects:

2 cats: Otto (neutered male, 11 months)
Bailey (spayed female, 7 years)

About ten months ago, Otto moved in and Bailey has been trying to adapt to his presence ever since. Her relationship with Otto has improved from the day he walked out of his carrier, but she still often hissed and growled at him whenever he came within half a metre of her. Prior to the experiment, she rarely played with him, and they hardly ever touched noses or showed any other kind of friendly behaviour.

Experimental Design:

My experiment ran into some problems, requiring us to change the design as I went along. I had originally intended to spend three days creating a base-line of Bailey's behaviour and Otto's holding latency, then I would continue on to the sham-treatment for another three days, while still observing. My experiment would come to a close after another several days of treatment.

I decided to keep the observations simple with Otto. My operational definition of his tension and aggression was how long he could be held before nibbling the fingers of the person holding him. (He loves being held, and licks fingers constantly, but always ends up biting at some point). I always used the same person to hold him (my father). I started timing from the moment he touched my father's chest to the time that he first nibbled my father's fingers.

For Bailey, whose major problem seems to be anxiety, I used a more complex operational definition. I wasn't sure exactly what would work in terms of measuring her anxiety, so I looked at a whole lot of different behaviours, including the position of her ears, what her eyes were doing, the state of her tail, and her body language. I also included my impressions of her mood. I created charts with these behaviours. I followed her around, and I observed whether or not these behaviours had occurred during each minute of a 15-minute period. At first we did this twice a day. Later, as the treatment took more time, I could only follow her around once a day because of time limitations.

I tried to do treatment at the same approximate time each evening. Observations were taken following treatment. This was difficult to fit in with normal life, so variations in time were not uncommon. Typically, observations occurred about twenty minutes after treatment. Our goal was to ensure the cats were no longer stressed from the act of treatment.

Baseline Design

I began my experiment by following Bailey around twice a day for fifteen minutes and recording body language, gross motor actions, vocalization and mood, as well as holding

Otto to see how long he could be held before nibbling at the fingers of the person holding him. I continued this for three days.

Informal Baseline Observations

Observations (other than those I recorded on my sheets) were minimal for the baseline as I was just looking for normal behaviours in both cats.

Sham Treatment Design

The sham treatment box was our first attempt at creating a way to treat the cats with CES. We (my father and I) lined a plastic cat carrier with two pieces of aluminum foil, and glued these down with silicone glue. We attached adhesive electrodes to the top of the tin foil, although in the sham treatment, these were not attached to the Alpha-Stim unit. We put a piece of wood down the middle of the box to encourage the cats to keep their left paws on one side, and their right paws on the other.

The sham treatment design consisted of putting the cats inside the box for 20 minutes, the same amount of time for a normal Alpha-Stim treatment length. I knew the sham treatment would be stressful for the cats, and this would allow me to observe the effects of that stress.

After the first day with the box, we observed that the cats tended to lie down on one side of the wood, which would prevent them from receiving any electrical stimulation (they would only be getting either positive or negative, and both are needed to create an electrical current). We added some Styrofoam blocks to the inside of the box to limit the space available to them, and encourage them to stay in the middle of the box.

On the second day, I put Otto in first. He chewed the corners of the styro-foam blocks, but otherwise left them alone. Bailey hated being squished in there so much that she destroyed our system. She shredded the Styrofoam into little bits, and tore at the aluminum foil. Because of the stress, we ended the Sham treatment phase earlier, with only 5 minutes of sham treatment for Bailey on the second day.

Informal Sham Treatment Observations

Both cats became stressed from their experiences in the box, though Otto may have had a small bit of fun chewing at the corners of the styro-foam. While in the box, he moved around a lot, he stuck his paws through the bar and tried to reach the latch, and he mewed a lot. Bailey did a lot of the same things, as well as digging at the floor of the box. Bailey was especially stressed on the second and final day of sham treatment, as she completely tore apart the styro-foam. The "explosion" of Styrofoam caused even more stress in both cats, as we had to vacuum the floor and the cats.

Earclips/Probes Treatment Design

I had originally avoided using the earclips because I thought that the cats would just shake them off. However, on January 16th, my dad got in contact with Dr. Daniel L. Kirsch, the leading expert in CES and chairman of the company which makes the Alpha-Stim. Dr. Kirsch sent us back via e-mail a brochure advertising the Alpha-Stim to vets, and a picture of his cat wearing ear clips. He encouraged us to try this approach.

The earclips and the probes have felt pads on the end that are soaked in Alpha-Stim conductive fluid. As I had predicted, the cats shook off the ear clips almost immediately. I repeatedly replaced the earclips, much to the dislike of the cats. After the first day, I decided to use handheld probes instead of the ear clips. I placed the probes on the cats' temples (just in front of the ears) while my father held them. The Alpha-Stim was set at 1 (about 100 microamperes). I found the probes to be alright because the cats were receiving treatment, though not for the recommended time. The cats tolerated it. Bailey in particular found this treatment to be quite stressful, and she struggled and growled frequently during treatment. Otto did not mind it as much, but he too would only put up with it for about five minutes before running away. The cats didn't like being held in place or touched with the probes. The electrical stimulation wasn't the source of their discomfort because it is set so low that it cannot be felt.

The cats received one day of treatment with the earclips, and five days of treatment with the probes.

Otto and Bailey receive probe treatment

Informal Earclips/Probes Treatment Observations

Both cats shook off the earclips after a matter of seconds, but that was only to be expected through the jumpy personalities of my cats. I reattached them repeatedly, but it did not seem likely that the cats would become used to them. After the earclip problem, I decided to use handheld probes. This was more effective than the earclips, as treatment

time went from five seconds to five minutes. However, we needed to hold the cats still. This stressed Bailey out almost to the extent of the sham box. During treatment, she vocalized angrily, and was trying to escape with more aggressive attempts than Otto. Otto, however, may have treated "treatment" as a game. The reason we only got five minutes out of the cats was the fact that the cats escaped at that time.

Revised Box Treatment Design

I was going to have to continue with probes until my dad came up with a brilliant idea for a revised box. We removed the tin foil sheets and replaced them with two sheets of metal. We covered the sharp edges with duct tape to keep the cats safe. These metal sheets were curved upwards from the centre of the bottom of the box, creating a half-tube which would encourage the cats to remain in the centre of the box. My father and I glued and bolted these to the cat carrier. We also glued a half tube over the wooden block in the centre of the box, creating a larger barrier between the two sides to again keep paws on either side. We attached the adhesive electrodes to the bottom of the metal so the cats couldn't pull at them or put their paws on top of them, which would reduce their treatment time. To make the box more comfortable, I put a heating pad under the box to warm it up. To treat the cats, I put electrode gel on each paw before putting them in the box. The first day I did this was probably the first day of good treatment for Bailey, as there was little to no vocalization (mewing, growling, hissing) when she was in the box without distraction and even when Otto was sitting on top and peering in.

Otto gets curious about the Revised Box

Both cats spent at least some time with their front paws on only one side of the divide between the two sheets of metal. On the second day, to encourage them further to remain in the centre with one front paw on each piece of metal, we put two blocks of wood on the sheets of metal to reduce the amount of space they had to move around. We continued treatment in the box for six days.

Informal Revised Box Treatment Observations

Both cats tolerated the revised box quite well, and we were able to get 20 minutes of treatment in on each day. At the beginning of the revised box treatment, Bailey was very reluctant to get in the box. By the end of it, she practically walked right in. In between treatments and scheduled observations, my parents noticed Bailey purring on their bed and we all noticed her standing up for herself whenever the "evil" Otto attacked. She also accepted Otto's presence whenever he was around, by not hissing or growling and actually placing herself beyond her usual boundaries around Otto. On at least one occasion, my parents saw her approach Otto and start playing with him, something she has almost never done before.

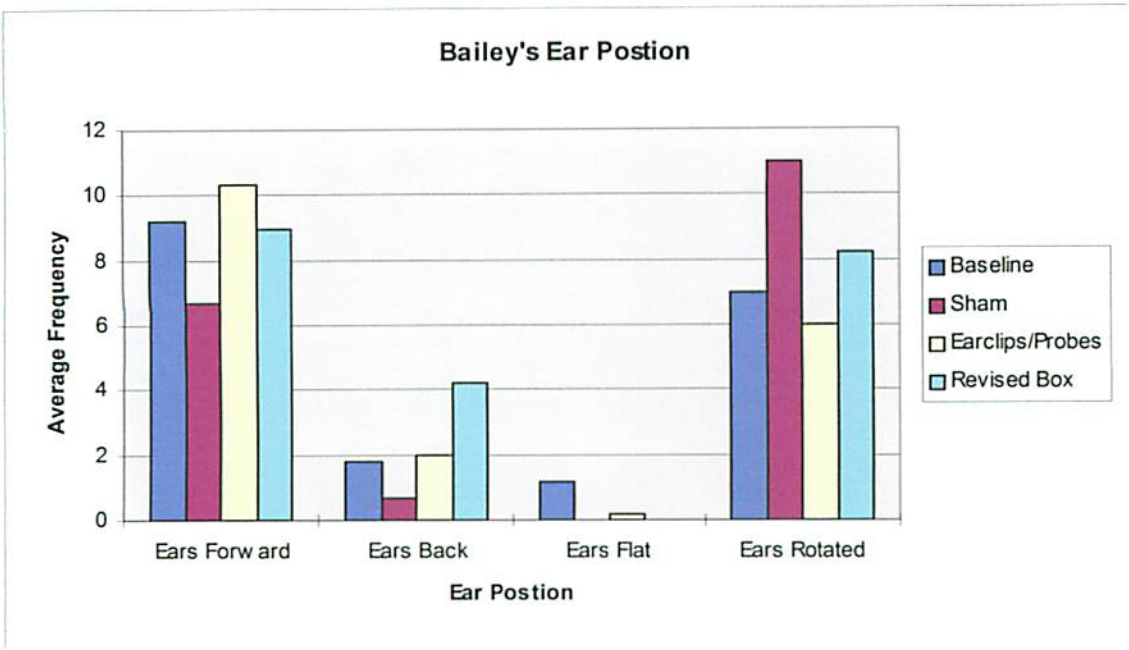
Bailey's first treatment in the Revised Box, supervised by Otto

For the first time in her seven-year life, after three days of active treatment, Bailey sat on my sister's lap and was very affectionate. She leapt up on Colleen's lap, sat there on her own, and let her pet her, while she purred loudly! She stayed there for several minutes.

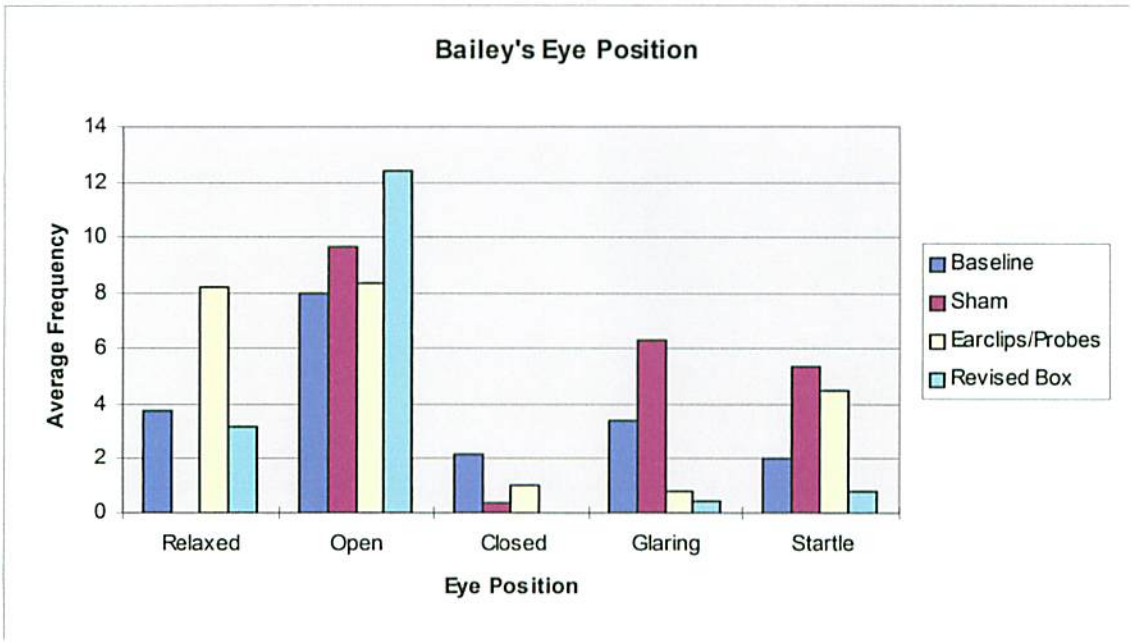
Otto appeared to actually be biting less and licking more, and allowed my sister and I to hold him longer; overall, he appeared more affectionate. Otto and Bailey have never been on such good terms before. The fact that they groomed each other and touched noses was the most amazing thing we'd ever seen. However, he still likes to attack Bailey, although this is in a playful manner, as it has been from the beginning.

Remarkable new behaviours, as these are things that they have never done before

Results

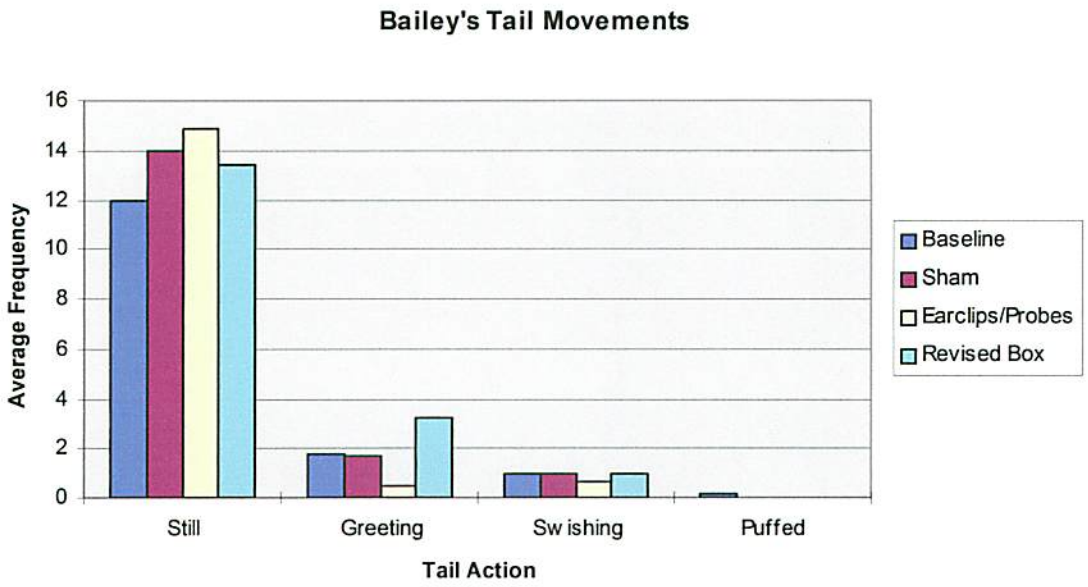


Prior to observation, we believed Ears Forward would be a measure of relaxation; Ears Back, Flat, or Rotated would represent stress. However, Bailey's ears would rotate even when she was not under stress. Ears Flat was extremely rare. Whenever Bailey washed herself, her ears went back. Therefore, increased washing following the Revised Box phase led to decreased Ears Forward, and increased Ears Back. This may partly be due to washing the electrode gel off her feet; this was used only in the Revised Box phase. However, she also seemed to wash her whole body along with her paws.

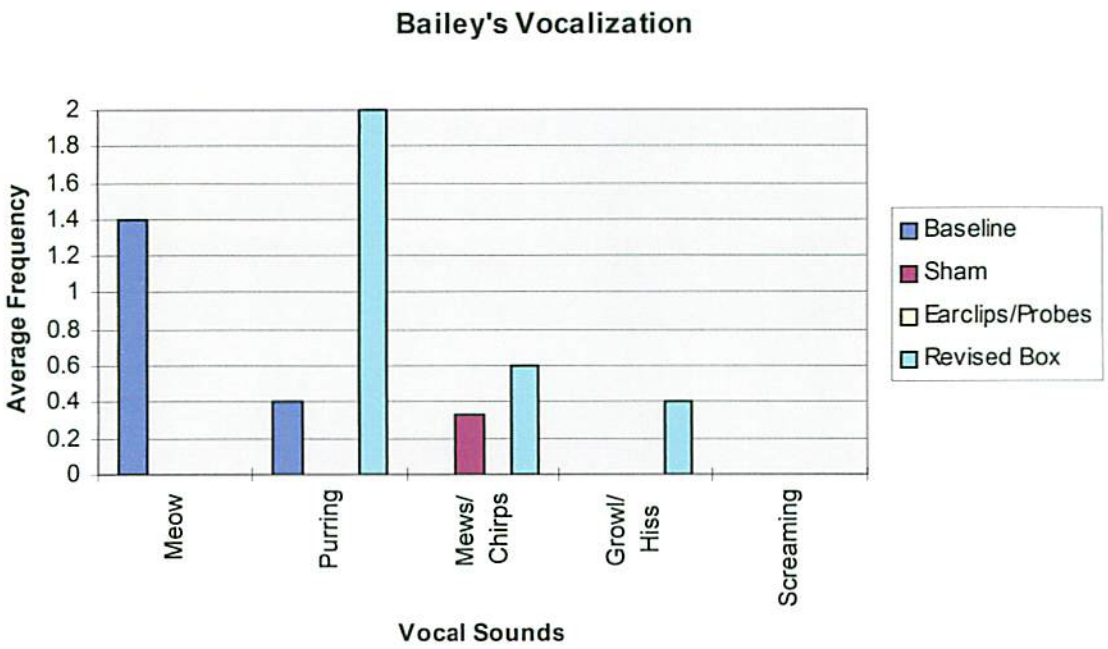


I assumed that Relaxed or Closed eyes represented relaxation. Eyes Open could represent alertness in either a relaxed or tense state. Eyes Glaring and Startle responses (a sudden, fearful reaction usually to a noise of some kind) represented stress.

This graph shows that during the Earclips/Probes phase, even though Bailey did not receive a full treatment, she may have benefited from some relaxation, even in spite of the stress of the treatment. The increase of Eyes Open in the Revised Box phase suggests that Bailey was getting closer to a normal treatment, as she was relaxed and alert at the same time. The Sham treatment shows evidence of stress. In this case, the Eyes Open represents more stress, with evidence for this coming from the increased Glaring and Startle responses.

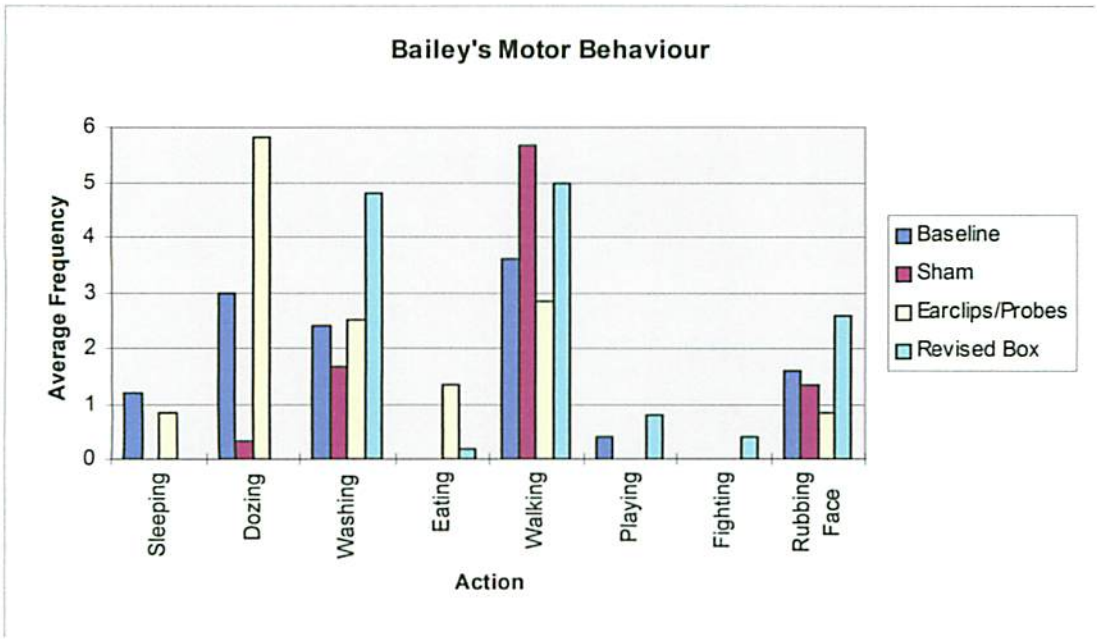


Cats' tails can often show their mood. When still, the cat may be relaxed; when in a candy-cane shape, the cat is greeting; when swishing, the cat is tense; when the tail is puffed, the cat is defensive. However, this graph shows little difference among the treatment conditions. Apparently, her tail was still most of the time.



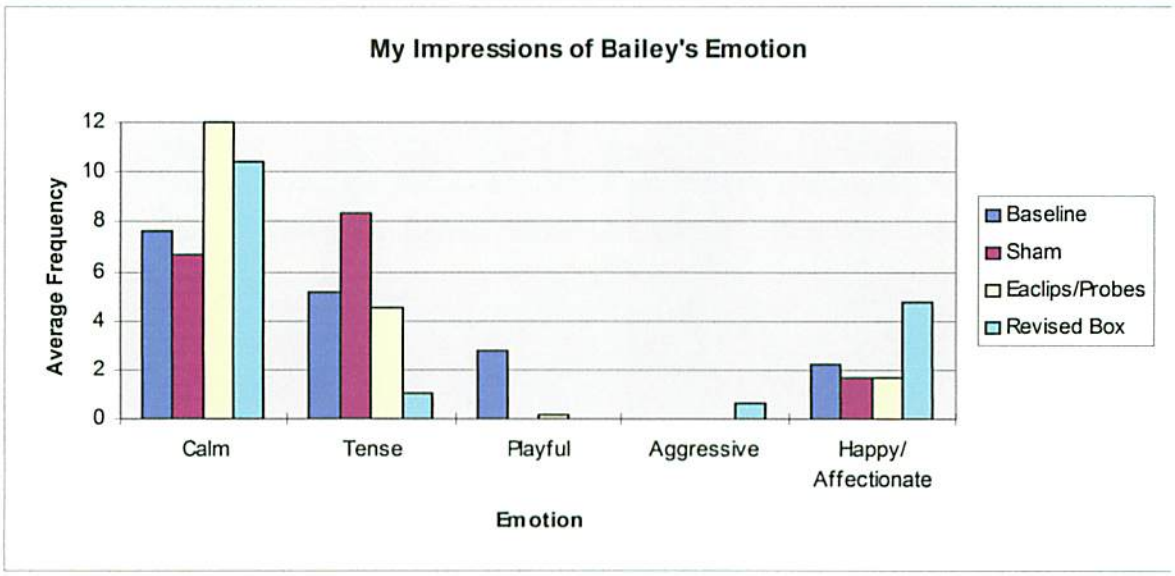
I rarely observed much vocalization during my experimentation, as it rarely occurs without interaction, and we tried to pull ourselves away from interfering with Bailey so we didn't influence her behaviour. The increased growling and hissing in the Revised Box phase was not an indication of increased aggression on her part, but was provoked by an attack by Otto. Actually, it was my impression that the fight was less intense than usual.

The purring occurred during a baseline observation in the basement. Unlike many small children, her favourite place in the house is in the basement. She often becomes very affectionate in the basement, and in fact, the only time she usually would put up with being on anybody's lap prior to this experiment was in my father's basement office (and that was only when he picked her up and put her there).



As I said before, the increased washing was a result of having the electrode gel on her paws, although she did also wash her body. The increased walking in the Sham phase was probably an indicator of stress. When she walked in the Revised Box phase, she appeared to be feeling affectionate, and was moving to rub her face on the furniture.

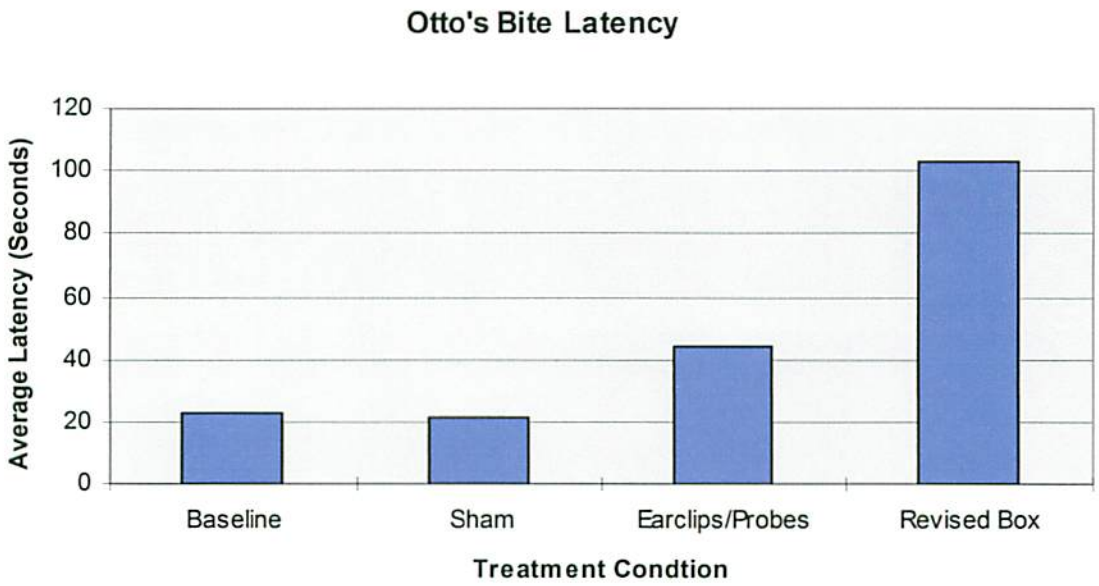
Dozing is like pre-sleeping for cats; they stay in one place, look off into space, and seem to drift away. This would be a measure of relaxation. When a cat dozes, it takes several minutes, so when it did occur the frequency was rather high.



These measures are different from the others. While scientifically defining a cat's emotion can be difficult, any cat owner will tell you that he or she can tell the emotions of their cats. Where the other measures look at specific behaviours, these measures are

based on my overall impression of her mood. However, these observations are more open to bias. Even though I did my best to eliminate my bias, I did want my experiment to work, and this could have influenced my observations.

The Sham treatment still proves to be a source of tension. In spite of the stress of the treatment itself, the Earclips/Probes phase produced the highest level of calmness, closely followed by the Revised Box. Tension was also lowest in the Revised Box phase. There was a large difference among the treatment conditions in Happy/Affectionate mood. Playfulness and Aggression were rarely observed.



This graph shows the clearest results of my project. The baseline is low, but not the lowest. The Sham treatment is lowest, but not by very much. The Earclips/Probes increased his bite latency by a noticeable amount, but has not reached the peak of treatment. In the Revised Box, the latency increased by a phenomenal amount, with our record of 180 seconds happening on the last day of treatment.

Conclusions

My study has had many limitations and challenges, and is not the best piece of research around. The many limitations of my experiment begin with time. I haven't been able to accommodate much in the way of experimentation, which is due to my extra-curricular activities and other homework. The ideal extent of treatment would be twenty minutes of pure treatment a day for two weeks, followed by less frequent treatments of the same length. Our cats received only about five to seven minutes of treatment through the earclips or probes, and I was only able to use the revised box for five days before the end of the experiment.

The next limitation is the complexity of a cat's behaviour. My project two years ago, which focused on mice, involved seeing if mice could learn. All I had to do to influence their behaviour was tempt them with a bit of sweetened water. A cat's behaviour is far more complex, and more difficult to control.

With Otto, I was trying to influence a single behavior, which isn't that complex. This is probably why I received very clear results with him. With Bailey, on the other hand, I was trying to influence a whole mood, which is infinitely more complex because a mood includes many behaviours. In some cases, it was also difficult to associate a behaviour with one mood, as "eyes open" could mean stressed, or calm and alert. Bailey's ears rotated backwards whenever she washed herself. Having ears back could also mean being frustrated or angry. It is not impossible to operationally define a mood, though specific behaviours must be examined in context. The best course of action for looking at anxiety in an animal might be physiological measures like heart rate, stress hormones, or blood pressure. However, we did not have access to the equipment required.

Another complexity of my project is that many of the positive results do not show up in my scheduled observations. Bailey sitting on my sister's lap for the first time is an incredibly important change in her behaviour, but it does not appear in the graphs based on my formal observations.

Another contributing limitation is bias. I wanted my experiment to be successful, for the sake of Bailey to improve her quality of life, and to reduce how often Otto nibbled on my fingers. Bias can influence how I interpret my results.

Another way bias could show is through my interpretation of Bailey's mood. Since mood is hard to scientifically identify, that subject is very open to bias.

Although my family and I are noticing many changes in the cats' behaviour, there is still a chance (however miniscule) that the heating pad may be involved in relaxation. The cats' comfort in the box may not have been from only the Alpha-Stim, but also from the heating pad placed underneath the box. I recognize the fact that this may have constituted a noticeable amount of comfort and relaxation, along with the Alpha-Stim. The heating pad was not present in the Sham treatment (we added it in the Revised Box phase to make being in the box more appealing), and so this part of the experiment was not controlled.

In the Sham phase, I knew that I was introducing some stress to the cats by putting them in the cat carrier. My original intention was to see what leading factors indicated stress. My parents and I believed that bringing on this stress was acceptable because being in a cat carrier isn't unusual for a cat, even if they don't like it. However, we didn't anticipate that Bailey would shred the Styrofoam. If Bailey was more co-operative with the Sham treatment, I might have a better operational definition of stress in cats.

Another limitation is one that focuses on Otto. Throughout my project, Otto learned that he could be put back on the ground if he nibbled my dad when he held him. This was

proved through his performance one night, when Bailey passed by and Otto nibbled my dad and leapt at Bailey after four seconds.

Though this massive list of limitations was all true, amazing results came out of the experiment. Time proved to not be an issue, as the treatment worked so well that I was able to demonstrate change even with a treatment phase that was shorter than recommended. Although I did not control for the use of a heating pad, Bailey has been on warm surfaces before, without showing changes in her behaviour like climbing onto my sister's lap hours later. That could pretty much rule out the heating pad as being the source of the good results. The only thing I believe the heating pad helped with was making the cats more comfortable in the box. Otto most certainly learned that biting would result in his being placed back on the ground. Despite that, the longer he was exposed to CES, the longer he allowed my father to hold him before nibbling.

Applications

My study may actually have been very important in CES research on animals, as I have shown that stimulating the whole body through the paws might actually influence emotion and behaviour. My project may not be the leader in CES research, but it may suggest a path for better research to occur. Stimulating the whole body at the same time might be very helpful.

The optimal treatment pattern for CES is to directly treat the brain. My system treated the entire body, which proved to be successful still. This may have occurred because of the electric action of the nervous system. If you stimulate the whole body with all its neurons, the stimulation is bound to reach the head at some point. Stimulating and relaxing the body may have also helped to calm down the brain, even if the brain was not directly treated.

My research may also have provided a way for an animal receiving treatment to receive it in a more comfortable way. CES is non-invasive when humans use it, but obviously, some animals (like ours) are reluctant to have the clips placed on their ears. In some research, this has been addressed by piercing animals' ears to attach electrodes, or implanting electrodes under the skin. In veterinary treatment, adhesive electrodes are sometimes used instead, but this requires shaving an animal, and preventing it from pulling the electrodes off. Using my cat carrier method involves no piercing on any parts of the body, and does not require things to be placed on or underneath the skin. We even came up with a way to treat the cats that doesn't require earclips or handheld probes. Less stress for the cats means better treatment.

The observations we have made have been amazing, and the cats have reacted to each other and us in ways they have never done before. On the 24th Bailey sat on my sister Colleen's lap for the first time. In fact, the only times she has ever done that before is in the basement on my father's lap while he works. On the morning of the 25th of January, Bailey and Otto groomed each other and rubbed noses. Otto began to bat at Bailey, but stopped and cleaned her ear, and she actually allowed this for nearly a minute. On the

26th, we saw Bailey playing with a large, crinkly cat toy in the shape of a tube. Otto plays with this tube all the time, but this was the first time we'd ever seen Bailey play with one of Otto's things. My experiment was so successful at creating positive changes in the cats' behaviour that our family plans to continue the treatment in the future.

Acknowledgements

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