The LENS Neurofeedback with Animals

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SUMMARY. *Background*. A customary route for research in the life sciences is to begin with animal studies, and only after thorough evaluation, attempt the same procedure with humans. In this pilot clinical outcomes study, the inverse procedure is followed. Encouraging results in the areas of CNS regulation led clinicians to explore whether the method is equally effective with animals who suffered the same problems as humans. The qualities studied included aggressiveness, mood instability, hypervigilance, inability to learn from experience. Species studies over about three years consisted of horses, dogs, and cats.

Method. All animals were treated on the Low Energy Neurofeedback System (LENS) using the I-330 C2, the mini-C2, or the GP plus EEG processor with a laptop computer. Unlike with human subjects, it was impossible to use "eyes-closed" condition, so blink artifact was impossible to rule out. Animals stood in stalls, tied to hitching posts (horses), or on the floor or in their owner's lap (dogs and cats). With most animals the "stim" condition was used, with a brief second or two of stimulation embedded in a longer period of "no-stim," four to twenty seconds depending on the situation. Where possible, a cortical map was done of from ten to twelve sites on the animal version of the standardized mapping system developed by Holliday and Williams (1999, 2003) to match human mapping. Since it has become available several months ago, the Animal CNS Questionnaire was used, and a five symptom or more "Subjective Symptom Checklist" completed on each treatment session with the owner. Narrative reports were collected from owners, but also from professional animal trainers and handlers. In some cases animals were photographed or videotaped before and after.

Results. The animal studies are similar in outcome to the human results. As judged by owners, independent witnesses and professional trainers and handlers, animal behavior improves in the di-

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mensions of flexibility, calmness, emotional stability, intelligence and problem solving The authors did not feel placebo "controls" were necessary or appropriate to these experiments. They had head injuries, survived natural catastrophes, or were abused or neglected (sorry to say) by owners. What was observed, in case after case, is that the more treatments administered the "easier" it became to administer additional treatments (animals were more complaint and calm).

Conclusion/Discussion. Results with animals are parallel to and confirmatory of results with human children and adults. Animals may be traumatized by many causes, not the least of which are human in origin. Thus it is rewarding to see a human procedure help them. With treatment, the animals seem more calm, adaptable, and natural. Some of the results resemble the easy and short-term treatments of human children and infants, who have not yet had a chance to acquire (more difficult to dislodge) habits and defense mechanisms around their problems. These studies are highly preliminary, but very encouraging. The authors would love to see the LENS method applied to a variety of species and in ever-increasing numbers. doi:10.1300/J184v10n02_08 *[Article copies available for a fee from The Haworth Document Delivery Service: 1-800-HAWORTH. E-mail address: <docdelivery@ haworthpress.com> Website: <http://www.HaworthPress.com>*

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INTRODUCTION

In the life sciences animal research has led to the discovery of many useful things with applicability to human health, illness, and its treatment. During the 1960s Neal Miller (1969), at Rockefeller University, was studying pleasure-center brain stimulation on rats paralyzed by curare. In response to a reinforcing stimulation the rats were able to speed or slow their heartbeat without muscular movement of any kind. Miller's work paralleled the work of Green, Green and Walters (1970) and Green and Green (1986) with yogis that showed that humans could likewise speed and slow their heart rate through meditative techniques.

Sterman and Friar (1971) and Sterman (1977), pioneers in the field of neurofeedback, discovered that brainwave patterns in cats could be modified and trained by operant conditioning. Cats that were able to increase the sensorimotor rhythm (SMR) were discovered to become much more seizure-resistant when they were later exposed to a toxic chemical that caused seizures. This serendipitous discovery led to research that successfully documented the ability of neurofeedback to reduce seizures in humans who suffered with uncontrolled epilepsy (Sterman & Friar, 2000; Egner & Sterman, 2006).

Thus Sterman's animal research with cats provided the foundation for assisting epilepsy patients, including workers in the aerospace industry who had been exposed to the toxic effects of monomethylhydrazine, a volatile component of rocket fuels. Sterman's discoveries initiated a whole generation of brainwave researchers exploring the potentials of neurofeedback with ADD/ADHD (Lubar, 2003; Monastra et al., 2005) and in a variety of other areas (Hammond, in press) including alcoholism and post-traumatic stress disorder (Peniston & Kulkosky, 1991; Peniston, Marrinan, Deming, & Kulkosky, 1993), learning disabilities (Fernandez et al., 2003), peak performance training (Egner & Gruzelier, 2003; Raymond, Sajid, Parkinson, & Gruzelier, 2005), and anxiety and depression (Hammond, 2005; Moore, 2000). Margaret Ayers, who uses a system with digital real-time neurofeedback, has also indicated that she has successfully treated dogs and horses with neurofeedback in the past twenty years (Ayers, 1987; Ayers, M. A., personal communication, September 10, 2005).

However, apart from Sterman's research and some unpublished case reports of Margaret Ayers, neurotherapy has only been applied to humans. This paper will report on the use of the Low Energy Neurofeedback System (LENS) in the treatment of a variety of problems in animals.

The LENS (Ochs, 2006) provides a unique and passive form of neurofeedback which produces its effects through the introduction of a very tiny electromagnetic signal. This stimulation, which is far weaker than the input we receive from simply holding a cell phone to our ear, is delivered for one second at a time down electrode wires. The frequency of the electromagnetic stimulation is determined, moment-to-moment, by the dominant frequency of the EEG which is measured in hertz or cycles per second, and updated 16 times per second. The client sits eyes closed, and the total time in which electromagnetic fields are received in a treatment session is usually only a few seconds at a small number of electrode sites on the head. This stimulation is believed to gently nudge the brain off of its stuck points, assisting it to become more flexible and self-regulating. Research (e.g., Donaldson, Sella, & Mueller, 1998; Mueller, Donaldson, Nelson, & Layman, 2001; Larsen, 2006; Schoenberger, Shiflett, Esty, Ochs, & Matheis, 2001), as well as clinical experience has found LENS rivals traditional forms of neurofeedback in the treatment of conditions such as traumatic brain injury, fibromyalgia, ADD/ADHD, depression, and other conditions (Larsen, 2006; Ochs, 1994, 1996).

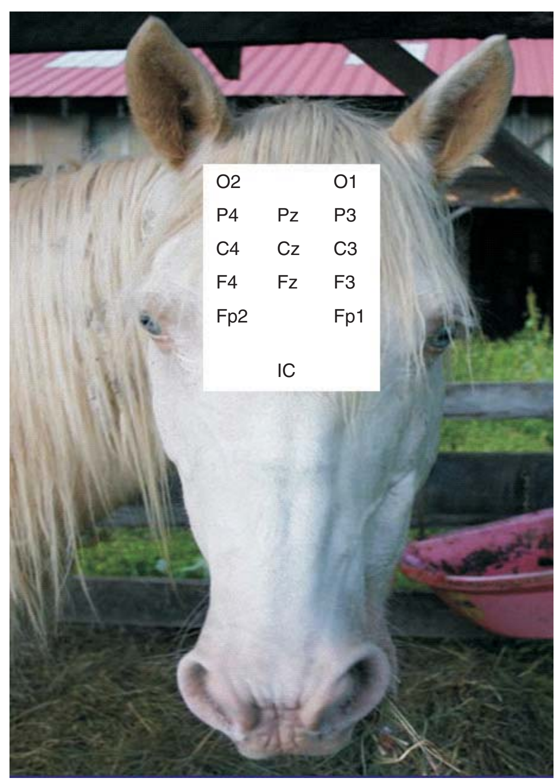
As shown in the CNS Questionnaire for Animals (see Appendix), animals often suffer from some of the same brain and CNS-based problems as humans: epilepsy, brain injuries, aggressiveness, depression, anxiety, lethargy, clumsiness, hypervigilance, restlessness, and attentional problems. Encouraged by the positive results with LENS training in humans, in 2003 we began to see if the LENS would assist in remediating problems in animals. The cases presented in this paper were collected from several different clinicians over about two and a half years. There are also some comments from Carla Adinaro, a professional dressage trainer, and other animal handlers. Other cases on the use of LENS with animals have been reported in an earlier publication (Larsen, 2006). We will summarize a few of the early cases from Larsen (2006) and then proceed in reporting some new cases in more detail.

METHOD

Animals were sometimes evaluated with a LENS map (Ochs, 2006) utilizing the veterinary version of the International 10-20 system of electrode placement, as published in Holliday and Williams (1999) and displayed in Figure 1. It can be seen that although the site map is depicted on a horse's brain, the same quantitative LENS mapping analysis procedures that are used in humans can be used in doing animal analyses. This was found to be appropriate in the cases where mapping was done, as if the difference between animals and humans were less important than the similarities. In general, the same brain wave ranges, as measured in hertz, and the same meanings attributed to high amplitude waves (measured in microvolts) seemed to be observed. All mapping and treatments were done with the J&J Engineering I-330 C2 and mini-C2 hardware.

Where it was not possible to do mapping, but treatment was urgent and the animal too aggressive to allow mapping, C3 and C4 electrode sites were used in treatment. This was especially true in cats and in small dogs where the heads are so small that it is difficult to differen-

FIGURE 1. Equine EEG (Adapted from Holliday and Williams, 1999)



tiate where one site left off and another began, especially when our standard size electrodes were used with very small animals. Although clinical experience (Ochs, 2006) has found that treatment in humans that is guided by a LENS mapping assessment is more effective, thus far we have no observations or data evaluating the efficacy of using mapping procedures to guide treatment in animals, versus using a more generic treatment approach using only C3 and C4 electrode sites.

Even though animals might be as sensitive or reactive as humans, in all the cases studied in this paper, the "stim" condition (10-18 Watts per sq.cm.) was used, while the energy background of the equipment was the "lo-stim" (10-21Watts per sq.cm.) as discussed by Ochs (2006). Two to six seconds of total treatment was the most commonly used protocol. The only mild over-stimulation effect that was observed in one case was when a clinician gave several seconds of treatment at each of five sites. The owner reported that the horse seemed "dopey" and somewhat clumsy the next day. As we commonly find with humans, the over-stimulation side effect wore off after about twenty-four hours and the horse showed behavioral improvement thereafter.

Treatment results with animals were evaluated by changes in behavior, body language, expression, energy, adaptability, and flexibility. Systematic symptom ratings were obtained on a number of the animals.

RESULTS

We will first briefly review several cases and then present the results of two recent cases.

Moondog

The very first animal we studied was "Moondog," a thirteen-year-old "Aussie" or Australian Shepherd, owned by Stephen and Robin Larsen, who showed depression and dyspraxia, possibly following a stroke and a series of spinal injuries that resulted from being struck by thousand-pound horses as she valiantly tried to "herd" them. Prior to treatment she was subdued and walked awkwardly with her back legs not "tracking" with her front legs. Felicitously, her treatment occurred during a LENS training program for professionals, and her condition before and afterwards were observed by a number of trained clinicians and skilled animal handlers.

Following treatment Moondog was noticeably more "perky," acting less depressed in her body language. Her sense of curiosity seemed to return and she explored her environment more actively. Her back legs became coordinated with her front legs. She was less clumsy and could climb in and out of cars better and ascend steps with more ease. Treatment was continued over her last two years of life at a frequency of about once a month. Moondog passed away in August, 2004 at almost 15 years of age. Moondog can be seen in Figure 2.

Dutch

Our next, quite exciting, animal case was Dutch, a "killer" horse who had been badly abused and would strike out at handlers with his hooves or pin people against walls. Adrenalin, and the idea of treating a horse with an evil reputation in a gloomy, unlit barn, did not keep us from observing dramatic changes in the horse's body language, after only two seconds of treatment each at C3 and at C4. These nonverbal changes included a huge sigh, a lowering of the head, and the commencing of a chewing response (indicating parasympathetic as opposed to sympathetic nervous system dominance). Dutch, who is seen in Figure 3, only received one treatment, but his owner/rescuer said he was more easily managed afterwards.

Dizzy

Dizzy the cat was our first feline subject (also seen in Figure 2). Though large and formidable

FIGURE 2. Moondog and Dizzy

FIGURE 3. Dutch, the "Killer" Horse

looking, he knew he was the "outsider" (owned by a woman staying for a few months in our guest house). Our own house cats, though smaller, had their home territory well established. Mother and daughter, they would gang up on the hapless Dizzy and terrorize him day or night. He presented as being hypervigilant and extremely anxious. His owner said he was fearful and wary most of the time.

Dizzy was held while the electrodes and paste were applied (Dizzy loved the electrodes and paste). A thick towel was placed on the lap of the person holding Dizzy during the treatment so she would not get little puncture wounds in her leg. During the LENS procedure our two house cats came around, full of indignation that this interloper was being entertained in the living room. They sat on the other side of a plate glass window and glared in the direction of the terrified and agitated Dizzy, while growling in stereo. Their attentions helped to distract Dizzy from the treatment procedure, however, and he received only 1 second of stimulation at C3 and 1 second at C4 (at a 20 Hz offset). After being released, he fled into the woodpile at high speed, only once looking back with a look that seemed to say, "All humans are definitely crazy."

It was not until two days later that one of the experimenters saw a strange thing. Arlecchina, one of the house cats, was growling, hissing loudly and slowly backing up along the porch, clearly nonplussed by a menacing *something*. Expecting to see a dog or even a fox, we were completely astonished by the stealthy advance of Dizzy toward his former adversary, somehow miraculously reversing the roles. Thereafter, over about three weeks until Dizzy and his owner departed, he held his ground and gave a little better than he got back to his tormentors.

Silver

Silver (see Figure 4) was an abused horse that came to the Stone Mountain Farm four years ago, at about fourteen years of age. He often seemed wary and grumpy. An albino Appaloosa, he was very myopic and light-sensitive. He was dyspraxic and tended to stumble when ridden. When being trained, or longed (trained on a line), he was mistrustful and short-tempered. While being groomed he would nip at people, grabbing their clothes or flesh–a response seldom found in a happy and balanced horse.

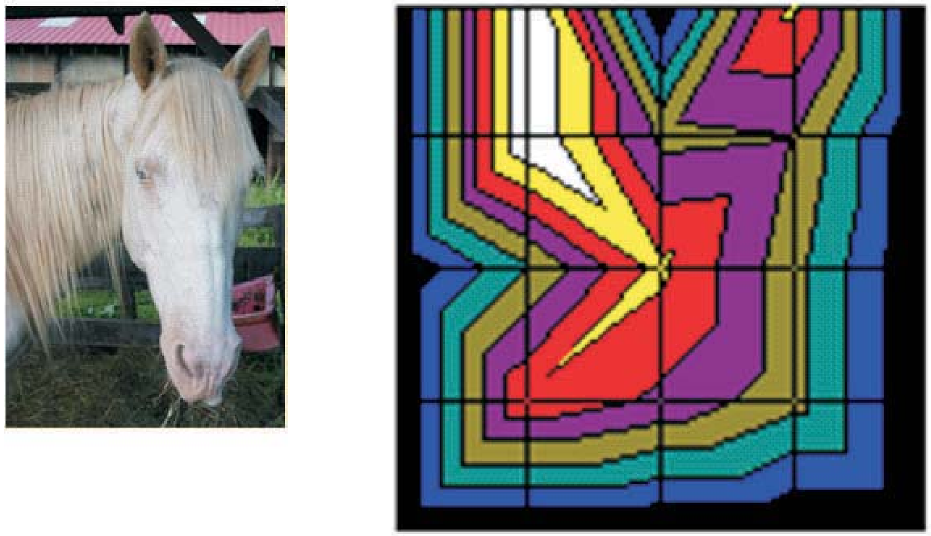
We were able to perform a LENS topographic map on Silver, which (as seen in Figure 4) revealed a very high-amplitude, dysregulated right frontal area (probably associated with an injury). After the mapping and a few stim treatments of no more than four seconds per treatment, our dressage instructor noticed that his expression had changed. Quite a number of people remarked that he seemed friendlier and happier. He no longer nipped at people.

Not long after treatment Silver was moved to a different farm. A horse trainer began to work with him and found him responsive and able to learn. He is being ridden as a trail horse and stumbles much less. He is now known as a "ridable" horse.

More Recent Cases

Gandalf the Grey (a rescued dog). Gandalf is a purebred Australian Shepherd dog. This breed (like Moondog) is known for their intelligence, vigilance, social instincts, and desire to herd everything from sheep to SUVs. Gandalf was purchased from a pet store, but his owners found him too active and energetic, so he spent nine months of his first year mostly in a "crate." Neighbors noticed that the dog was being neglected, because they never saw him in the yard or taken for a walk. After a period of time "Aus-

FIGURE 4. Silver the Horse and His LENS Map



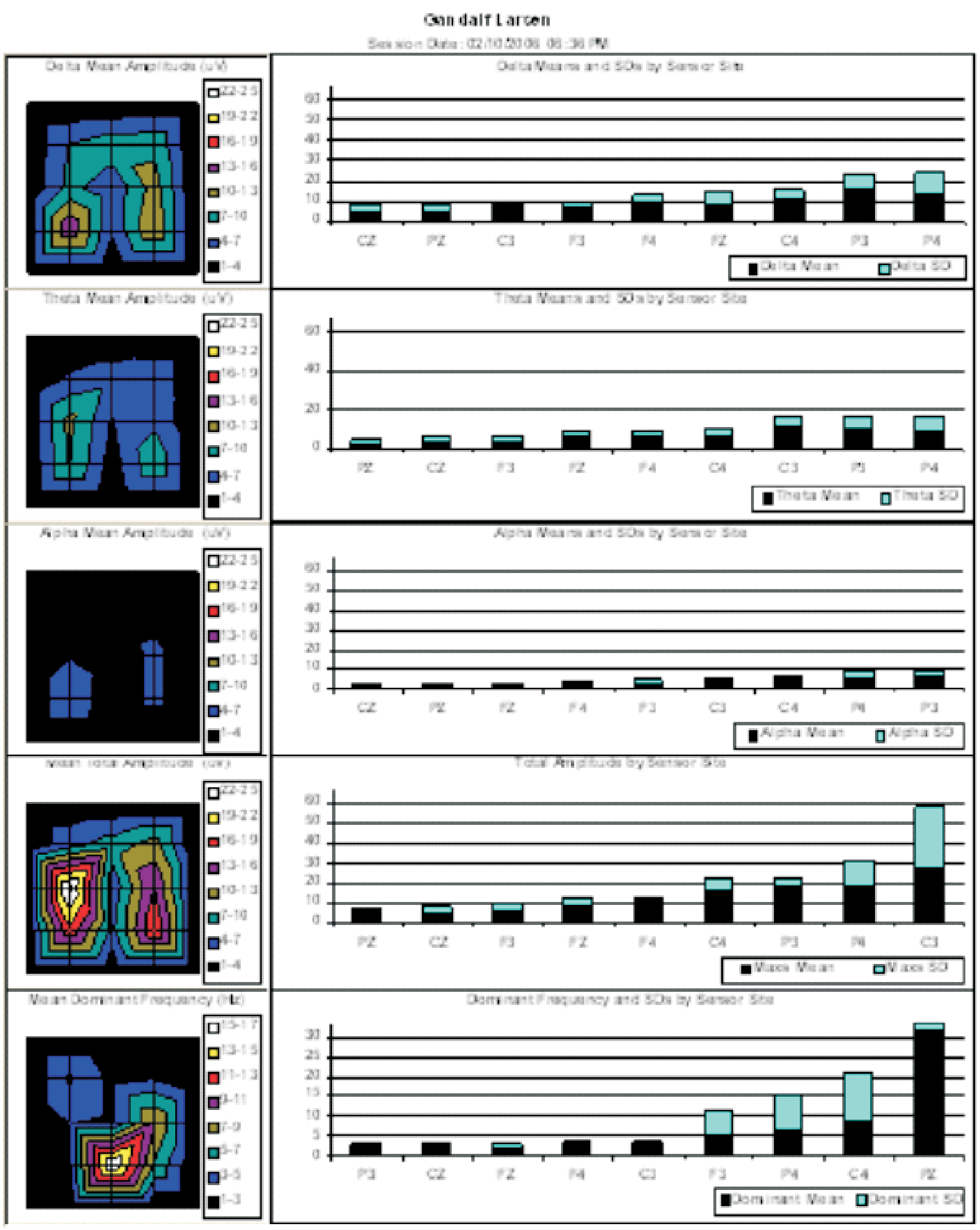
sie Rescue" was called and the dog was brought to an interim home with other dogs. After an interview and site visit, the excellent rescue team agreed to place him with two of the authors at Stone Mountain Farm.

Gandalf was anxious, immature, hypervigilant, extremely noisy, occasionally did fear biting, and was fearful of strangers. He was especially reactive to dark and bearded men (we know nothing of the history that led to this response). He bit a couple of our staff and friends. When we brought him home he was incontinent, erratic, suspicious, and would furiously bark at invisible things. He could not go up and down stairs because of an atrophied back end (from being locked in a cage for so long). The veterinarian said that he had hip dysplasia. He was impulsive, which would be manifested by running away off the leash and car-chasing, as well as "counter-surfing" (we found that many things, supposedly placed out of reach, had a way of disappearing). From his response to the Animal CNS Questionnaire we identified and scored eight areas of concern on a scale from 10 (worst) to zero (no problem). His greatest pre-treatment problems were summarized as hypervigilance (which was manifested by wild barking at most people), anxiety, having a weak back end, impulsiveness, incontinence, social immaturity, "counter surfing," and chasing cars or tractors (or almost anything else). His average behavior problem ratings before commencing with LENS treatment were 8.75. There was, of course, some overlap between the rated areas. Problem behaviors were rated by staff and others who came in contact with the dog.

Admittedly, treating such an animal was a tricky situation. The Aussie Rescue staff was worried that we would not be able to keep the dog because of his erratic behaviors and that we would have to return him. Gandalf was, of course, also handled gently, but firmly, petted, talked to, taken for rides in the car, fed and exercised, and taken for walks around the farm. Thus these are confounding variables and it is impossible to separate the effects of these ordinary activities with an adopted pet that had been very neglected and damaged, from the neurofeedback. Therefore, neurofeedback can be considered as one (unusual) component in a therapeutic milieu. The LENS treatments followed the map and site sort, averaging two or three sites per treatment, with one second of input at each site. He was given five photonic stimulation treatments of about five minutes each for his hind-end weakness. Photonic stimulation involves the use of infrared light that is used to assist with conditions such as pain, muscle and nerve problems.

The first treatment with Gandalf was extremely difficult because of restlessness, biting at the wires and head-jerking. One treatment with one second of stimulation at C3 and C4 was done before doing a LENS map. Gandalf was held while the electrodes were applied and the computer ran. His shrill barking at the therapy center made the staff and everyone else very jumpy and irritated. We had trepidations about doing a map, but we wanted to guide treatment in the manner that we do with humans, as well as for research purposes. Mapping was done at 9 sites instead of 13, although Holliday and Williams (1999) advise that it is possible to use 13 electrode sites with a large dog. Gandalf's head was small and thus we decided to stay with the "inner circle" as displayed in Gandalf's maps in Figure 5. The electrode sites we mapped and treated were F3, C3, P3, P4, C4, F4, Fz, Cz, Pz.

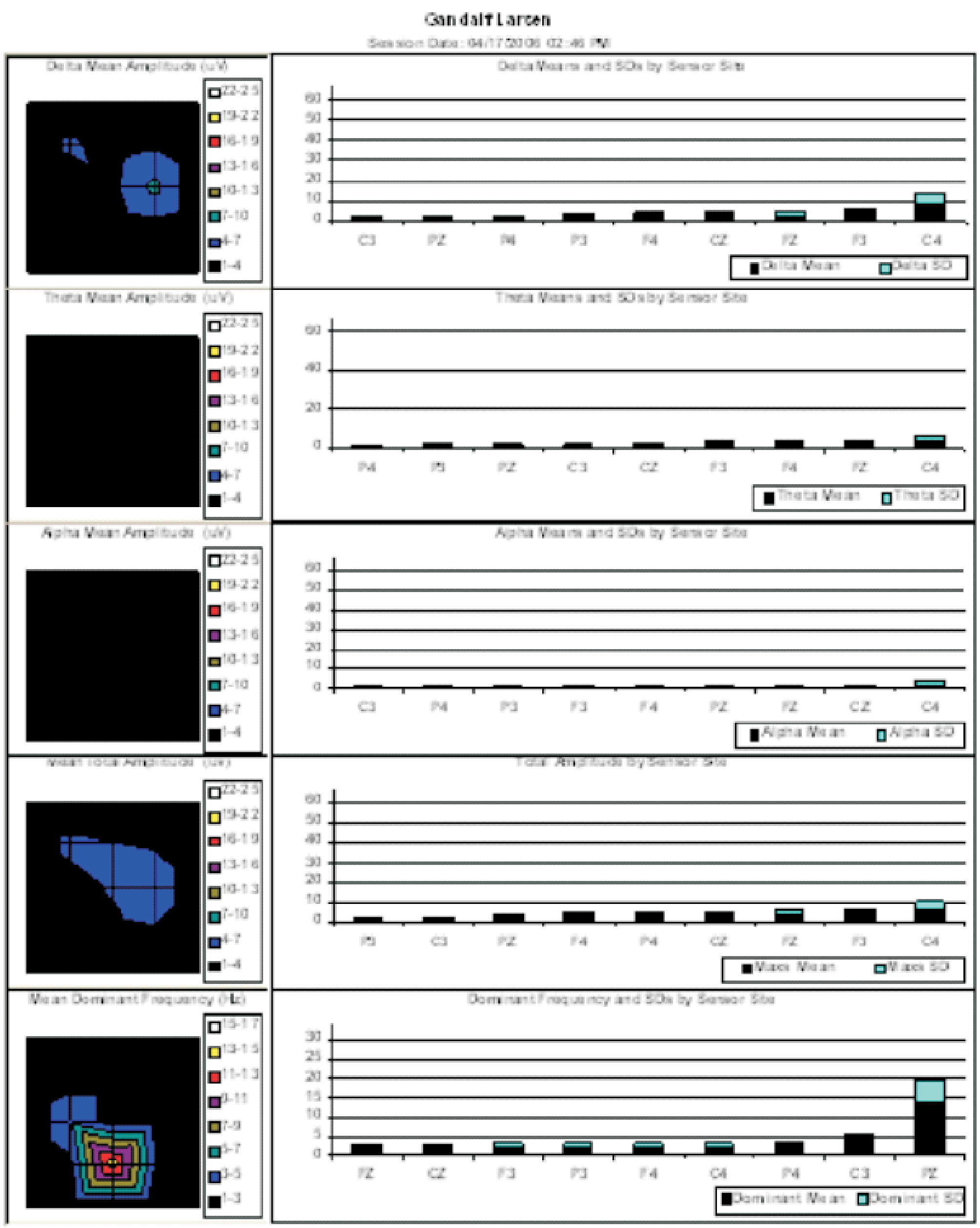
FIGURE 5. Gandalf Pre-Treatment LENS Map



Photonic stimulation treatment was extremely difficult. Gandalf seemed to think the photon stimulator or its wand were a kind of sinister vacuum cleaner, intent on making him miserable. However, with this treatment too, he learned to stand still and receive it after the first few treatments. The post treatment results can be seen in Figure 6 which shows the Gandalf Lens Map indicating low amplitudes and decrease in bright colors on the histogram.

As of the time of the second ratings there is no doubt about his new family keeping Gandalf the Grey. As the anxiety has relaxed, a loving and cute doggy nature has come out. He is far more playful. He has become a champion ball and Frisbee chaser. If left in the car while we are shopping or in a restaurant, he waits patiently. He has bonded with several of our most frequently seen dark-bearded male patients, and

FIGURE 6. Gandalf Post-Treatment LENS Map



no longer barks hysterically at them–in fact, he cuddles nicely with one bearded gentleman. He was initially guarded and aversive toward a bearded male who was wearing a large felt hat when Gandalf first met him. He barked and growled incessantly and shrilly. Now he follows the same man around, responds to commands of "sit" and "down," lying all the way down, and occasionally coming over and resting his head on the man's knee while seeming to smile a doggy smile.

Jock the Dog. Jock was an English Bull Terrier, born in July of 2004. His owners acquired him at eight weeks of age from a breeder in South Africa. He seemed quite normal for the first five to six months of his life. He was very playful, affectionate, and trainable. He was given a lot of activity including frequent hikes in the mountains and plenty of off-leash exercise each week at a local nature park. He graduated from a six-week puppy obedience class and a six-week basic obedience class. He did not have any problems with house training or separation anxiety. He could be described as "headstrong," but at a normal level for bull terriers.

At about five to six months of age, Jock began chasing his tail and even biting his tail when he could catch it. This was fairly infrequent at first, but gradually became a very frequent behavior. Although he had a very active lifestyle, it was speculated that he perhaps needed even more activity and the frequency of his exercise was increased from three to four times per week to almost daily. That seemed to help for a while. It was also noted that defecating seemed to help to some degree.

Unfortunately, Jock's tail chasing gradually became more frequent, of longer duration, and more intense. By fifteen months of age, he was spending between 30 and 50 percent of his waking time chasing his tail. He even began interrupting favorite activities such as playing and hiking to chase his tail. It also became increasingly difficult to distract him from this activity.

The concerns of his owners that his tail chasing might be related to an emotional problem increased, but this was eventually ruled out by a veterinarian. He was placed on Amitryptaline, but this did not improve his behavior. One of his owners works seasonally and was able to spend time with him most of the day every day, providing him with a great deal of attention, affection, and playtime. As a result, boredom and loneliness could be ruled out. He was generally very well-behaved and rarely needed to be disciplined. His owners tried a variety of behavioral interventions to address the tail chasing, such as interrupting the behavior and rewarding alternative behaviors, but this did not help. Jock was also very sociable and got along very well with people and other dogs. These factors convinced his owners that his tail chasing had a medical basis.

Finally, Jock began to experience personality changes. As noted, he was generally very sociable and not in the least aggressive. However, he began showing increased irritability at night. This first began at about one year of age and was most consistent in the evenings. For example, if he fell asleep in the evening before his normal bedtime and was then awakened, he would become irritable and growl. His hair would stand up and he would walk about with very stiff legs. This went on for several months. He had a one-week episode of snapping at his owner's feet when awakened, but this subsided. However, at about fifteen months of age he attacked and bit his owner's ankle without warning. This occurred in the morning and he continued to have outbursts of aggression for several hours thereafter. At the same time, his legs were noted to shake fairly vigorously. This was very unusual behavior, especially given that the morning was one of his most affectionate times of the day. From that point on, he displayed violent aggression if awakened suddenly in the morning or in the evening. He was usually good natured during the day, but continued to have progressive problems with tail-chasing. His owners attempted to manage his aggression by kenneling him in the evening and gradually waking him up in the morning. This primarily prevented violent outbursts, but he continued to show irritability and growling.

The tail chasing combined with the personality changes and violent outbursts convinced his owners that something of a medical nature was wrong. He received progressively increased attention from veterinarians, particularly after the violent outbursts. This included a veterinarian with a 30-year history of breeding bull terriers and consultation from specialists at Tufts University School of Veterinary Science. Jock's blood chemistry (including thyroid function) was normal. Blood tests indicated normal kidney and liver function. A hypo-allergenic diet was tried, but without benefit. Ultimately, the aggression and tail-chasing were diagnosed as being due to a complex partial seizure disorder. The tail chasing syndrome is not well understood, but it is being actively researched from a genetic standpoint at Tufts University. There has been some speculation that this is a form of predatory behavior that is essentially "misfiring" and associated with seizure activity. The violence problems were described as a "rage syndrome," most common in cocker spaniels. Like Jock, the violent outbursts are most common in cocker spaniels when suddenly going from sleep to wakefulness, but can happen at any time. At about seventeen months of age, Jock bit his owner again, but this time in the face. The bite was severe enough to necessitate twelve stitches. At that point, his owners were on the verge of having Jock euthanized.

In a last ditch attempt to treat Jock's problems, LENS was used. Behavioral ratings for tail chasing, aggression, and other behaviors were started three days prior to Jock's first treatment. It was initially quite difficult to treat Jock with the LENS system. He appeared to be frightened by having electrodes applied to his scalp and ears, and reacted with aggression and strong efforts to escape the situation. Jock was almost 60 pounds of muscle and had been known to pull one of his owners for two miles uphill on cross country skis. Thus, when Jock became aggressive, it was exceptionally difficult to control him. The first attempt at treatment was aborted for these reasons. His veterinarian subsequently prescribed Valium to calm him for each treatment. Jock had a very strong constitution and it required 35mg of Valium to relax him sufficiently to allow the electrodes to be placed and the treatment administered. The initial treatment took place at the clinician's home. However, the novelty of this environment was very stimulating and it was difficult to get Jock to sit still for the procedure, even with the Valium. The first treatment was successfully applied, however, on December 17, 2005. This involved a one-second input each at C3 and C4 locations. It was also found that treating him in his own home environment was much easier. Jock underwent three more treatments at home on December 18, 23 and 26, 2005. The second and third treatments involved two, one-second inputs to both C3 and C4. The fourth treatment involved a one-second input to C3 and C4.

After the first LENS treatment there was an immediate, dramatic decrease in both tail chasing and irritability. He became much more contented and playful. He engaged in minimal tail chasing and it was easy to redirect him when he did chase his tail. He did not show any aggressiveness in the evening through either growling or outright violence. He continued to essentially sustain these improvements for several days after the second treatment. His personality was very much like it had been prior to the onset of the problems with irritability and aggression. He then began to show a slight increase in nighttime irritability and a more significant increase in tail chasing. His aggression again decreased very dramatically after the third treatment and he essentially had no problems with irritability or aggression from that point onward. The results were really quite startling.

Unfortunately, the tail chasing continued to worsen even after treatments three and four. It reached a point where he was chasing his tail almost continuously when awake. He twice caught and bit his tail to the point of severe bleeding, afterwards thrashing his tail around, flipping blood everywhere throughout the kitchen until it appeared like a crime scene. He was chasing his tail so much that he would collapse from exhaustion for a few minutes and then resume this activity. He panted constantly and seemed to be overheating. It was impossible to interrupt his behavior except by holding him. He would whine and shake when held and immediately resume tail chasing when released. Jock seemed to be suffering terribly and was euthanized on December 28, 2005.

It appears that the LENS treatment had a very significant, beneficial impact on Jock's rage problem and presumably his seizures. He reverted to his usual loving, affectionate self almost immediately after the first two treatments. The second through fourth treatments seemed to only reinforce this improvement and his aggression was essentially eliminated. Unfortunately, the LENS treatment only had a temporary benefit with the tail chasing. It is unclear why this was the case. It may be that Jock had a particularly strong genetic basis for this behavior that could not be overcome by the LENS treatment. Alternatively, it may be that the LENS treatment helped the aggression, but perhaps exacerbated the tail chasing, or that treatment at other electrode sites might have provided additional benefits if it had been done. Further research will be needed to investigate the effects of LENS on epipleptiform and aggressive behavior. A summary of daily behavioral ratings may be found in Figure 7. It can be seen that following the initial two day baseline, problematic behaviors dramatically decreased and stabilized, with the exception of tail chasing.

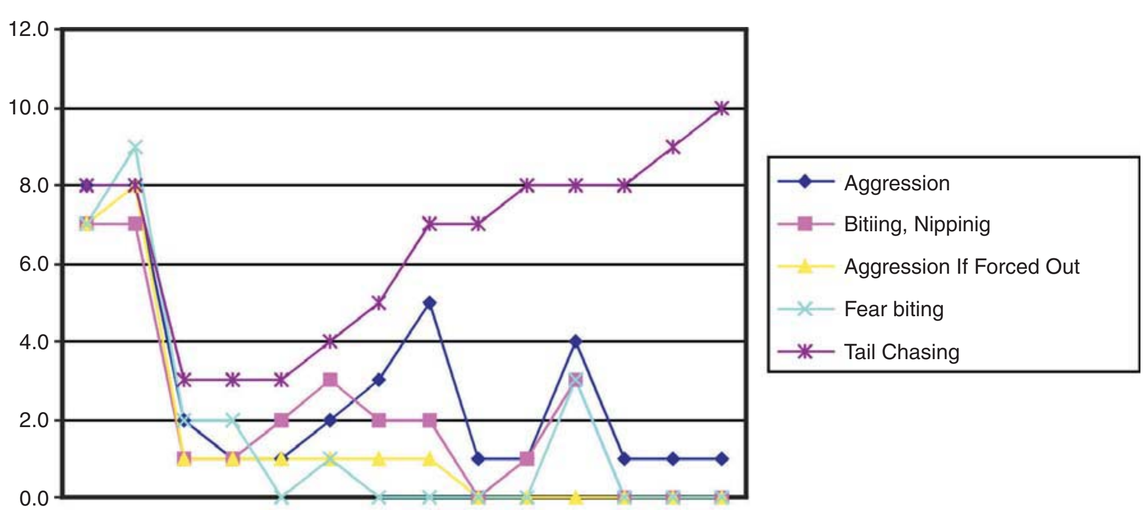
DISCUSSION

Our experience and review of literature suggests that the central nervous system of warm-blooded animals and humans seem to work in relatively congruent ways. As such, it can be anticipated that abnormal brain wave patterns like those seen in human cases of aggression, impulsivity, anxiety, depression, epilepsy, head injury, and other clinical conditions are also likely to be found in animals. When this is the case, neurofeedback may have potential to assist the behavioral and brain dysfunctions of animals as well as humans.

The LENS neurofeedback only requires the subject to remain motionless for a few seconds and does not require concentration. Therefore, it seems ideally suited to work with animals and small children. Positive effects are often seen after only a few treatments, although in animals as well as humans, a certain number of repeated treatments seem necessary for the positive improvements to become enduring. Small children and animals are more innocent and free of the various defense mechanisms so common in adults. For this reason we may be able to discern more readily the effects of neurofeedback treatment with these groups. A dog or a horse is not particularly impressed by the fact that just because electrodes are being put on his head that he should feel and behave better.

Admittedly the results of our initial uncontrolled case reports with animals are preliminary, based on a limited sample, and they only involved three species. Nonetheless, we observed positive behavioral changes in all cases. We are encouraged by the initial results and believe that other clinicians, as well as researchers, will find that after only a very small number of LENS treatment sessions that animals with behavioral or brain-related problems will become easier to treat. Wires are less likely to be ripped off or equipment damaged. Clinical experience has suggested that sometimes it might be advisable with highly reactive animals to use photonic stimulation for a couple of sessions prior to LENS treatment to calm them and relieve their pain or irritation. With "fear-biting"

FIGURE 7. Jock and Dog Pre- and Post-Treatment Ratings



dogs a muzzle might be employed for the safety of the clinician/experimenter. Normally animals must be sedated or rigidly confined (locked into braces or restraints) in order to perform EEGs. Our work is unique in that the animals were awake with sedation only required in one case, and the only restraints consisted of humans gently holding the animals.

The animals in our cases were domestic or farm animals, accustomed to interaction with humans, rather than wild or laboratory subjects. It has clearly been our impression that the problems in these animals have often stemmed from less than ideal treatment by humans, and so it is encouraging to us to find that a therapeutic procedure that evolved for treating humans may also be helpful for animals. All too often animals that are having problems are simply "put down." We are pleased to think that a gentle and relatively rapid treatment such as LENS may improve the quality of life of pets that are often very loved by their owners, and it may give many animals a chance to live.

The nature of the LENS provides a unique opportunity for placebo-controlled, double-blinded research with animals (as well as humans). We hope that future research will include animals of several different species. We believe, as in the case of Gandalf that rescue animals who have suffered from accidents or human abuse, as well as animals with head injuries, in zoos or circuses, and that have problems with aggressiveness or obsessive responses, may be ideal candidates for treatment and research. LENS seems to hold promise offering many of these unfortunate animals a chance for a happier adaptation to their lives with a healthier central nervous system.

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APPENDIX

CNS Questionnaire for Animals

Name:____

Rate all relevant items on a scale of 0-10 (10 is the worst possible, 0 means the problem ceases to be relevant)

Cognitive/Mental **Dates:**

Cognitive/Mental
Anticipatory, trying too hard
Ungenerous, miserly with mental effort
Stuck, inability to learn new behaviors
Rigid, inability to unlearn old behaviors
Poor Memory
ADHD or ADD type behaviors
Suspicious

Sensitivity/Reactivity

Sensitivity/Reactivity
Startles easily, hypervigilant
Reacts to fly spray
Reacts negatively to washing/brushing

APPENDIX (continued)

Neurological Problems	**Dates:**
Head tilting	
Tongue lolling	
Anxiety	
Depression	
Panic attacks, heart pounding	
Nervous sweating	
Nervous gulping	
Restlessness	
Overly fearful, phobic	
Muscular tension (in jaw, neck, back)	

Social Problems
Dominance problem, excessively aggressive
Fear of solitude, exaggerated
Screaming, neighing
Excluded/Rejected other animals
Rough play, Compulsive

Behavioral Problems
Stall walking/Fence pacing
Cribbing, chewing on foreign objects
Eating dirt, manure
Tense, rigid movements
Inability to accept normal handling
Explosive, can't return to normal
Kicking at air
Head bobbing, swinging
Trailering phobia
Biting, nipping

Physiological/Medical Conditions	Dates:
Lethargic, dull	
Lyme disease	

Primarily Dogs

Aggression to other animals	
Aggression to humans	
Disobedient	
Runs away	
Self-mutilation, chewing, scratching	
Stubborn, refuses to be trained	
Housebreaking problem	
Spite soiling to punish owners	
Passive/Aggressive	
Chases cars	
Barking, neurotic	
Hides, especially after bad behavior	
Aggressive if you force him/her out	
Fear biting or sudden biting	
Inappropriate rolling-over	
Gets into garbage	
Gets on furniture, even when scolded	
Tail chasing	

Primarily Cats

Biting/clawing as play becomes suddenly aggressive	
Aggressive to other animals	
Aggressive toward people	
Spraying inside house	
Other housebreaking problem	
Overeating, eating too fast, throwing up	
Ripping fur out	

APPENDIX (continued)

Primarily Cats (continued) **Dates:**

Jumps on table or other furniture when knowing it's forbidden
Digs claws in while on lap or being petted
Distant, unaffectionate
Excessively affectionate