

Immediate and Cumulative Benefits from Tellington TTouch Program Reflected in the EEG of An Anxious Mare

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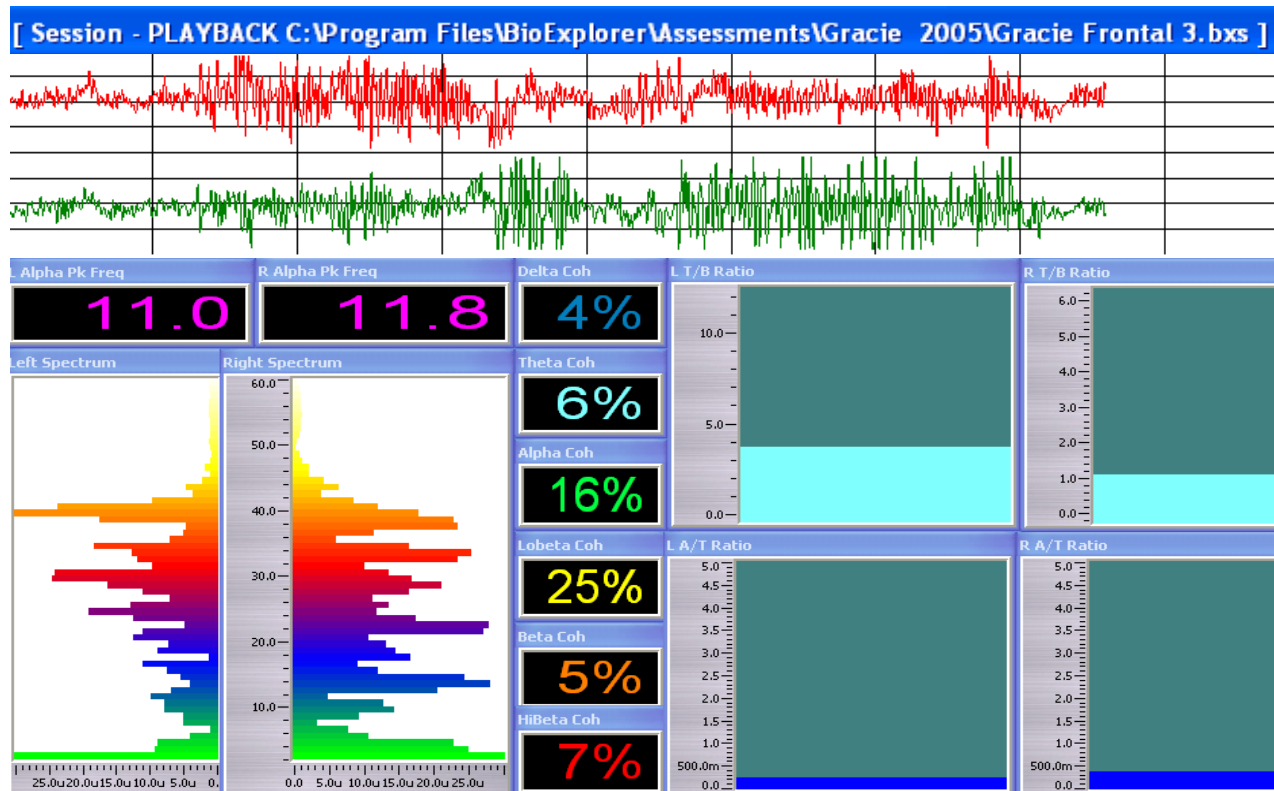
Linda Tellington-Jones has created a gentle non-invasive system of bodywork comprised of specialized circular touches, lifts and slides that improves focus, balance and motor function, enhances learning and even promotes trust and communication amongst its users. Over the past 30 years, practitioners have seen both immediate and cumulative benefit from its use in training and healing animals and in healing the relationship between animals and their owners. After attending one of Linda's 5-day workshops in April 2005, I wanted to see if these techniques could help my injured mare to be comfortable while healing from a ligament injury and help us to improve our ability to communicate so that her balance problems under saddle would not degenerate into rushing out of control.

We used subjective observation and objective brain wave measurements to evaluate the efficacy of the TTouch method. The EEG, or the electroencephalogram, is a measurement of the energy emitted while the brain is working. Neurofeedback practitioners, like myself, have learned how the EEG reflects specific mental processes. I knew that we could interpret changes in my horse's EEG, both immediately after TTouch and over the course of one year and compare the objective measurements to the observed behavioral and personality changes that might occur from a TTouch program.

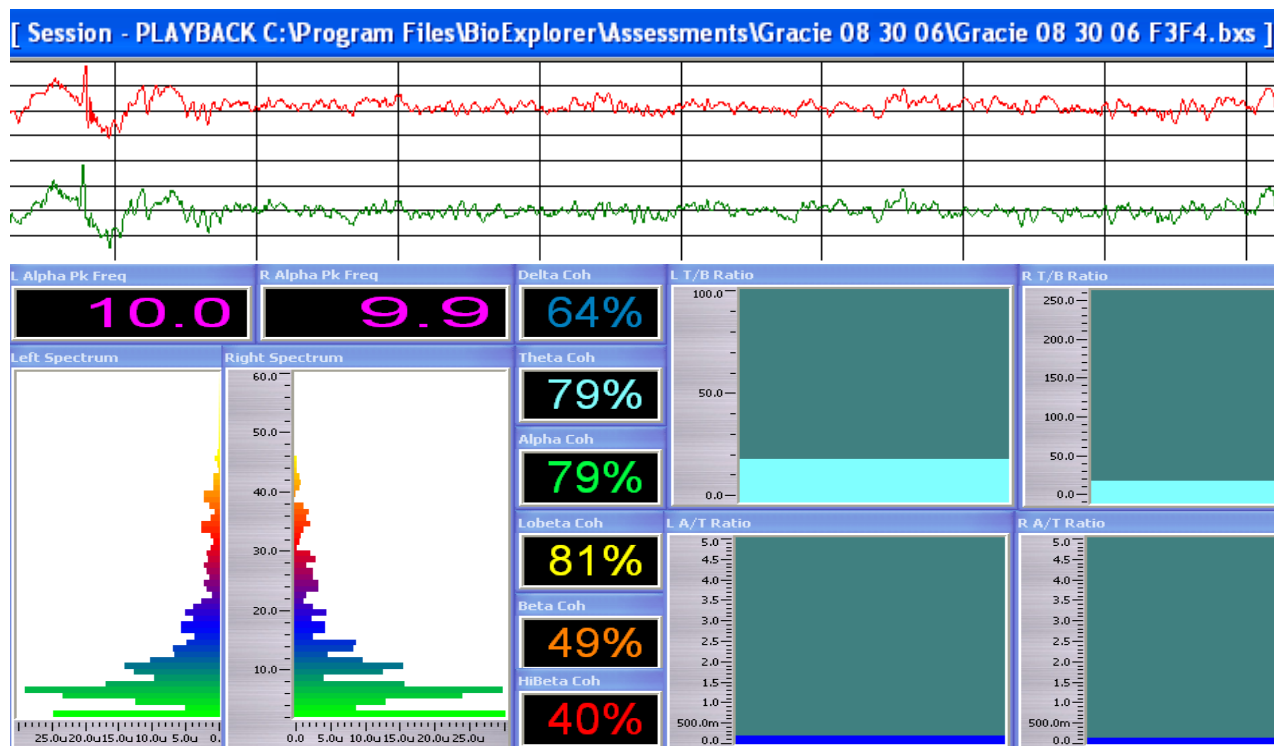
My horse's postural, behavioral and emotional changes were observable within moments of using TTouch and these changes were reflected in the EEG measurements being taken simultaneously. Over the course of one year, enduring changes in brain wave patterns had shifted so incredibly that I would not have believed the changes if I hadn't taken the measurements myself! The initial assessment of my horse showed patterns associated with severe PTSD and the final assessment showed a very, very calm horse. There were changes in my horse's behavior, personality and relationship to me that kept improving over time and that were reflected in the changes in the EEG measurements from the beginning to the end of the year. (See the postural changes in the images below.)



The postural changes that occurred over the course of Grace's TTouch training. Pictured on the left is Grace in December 2004 and on the right in June 2006. The leading position in the image on the right is called "The Journey of the Homing Pigeon" where Grace is led by two people with two leads and two wands. The resulting sense of security and relaxation allowed her to open her back, swing her hips and drop her head.



This is an image of my computer screen taken during the assessment of Grace's frontal lobes in 2005. The EEG pattern at the top of the screen in red and green lines shows the raw EEG from the left frontal lobe (red) and the right frontal lobe (green). This EEG pattern shows high amplitudes of fast frequency waves. The spectrograph in the bottom left corner of the screen above shows the EEG broken down into frequencies. We see activity all the way up to and above 42 hertz. An abundance of fast frequency activity (over 18-23 hertz) is associated with tension, anxiety and problems with impulse control. Those familiar with EEG readings may be tempted to interpret the above image as muscle tension in the scalp, chewing or eye-blink interference. I do not believe that is the case here. There is an eye blink pattern in the image below at the very beginning of the raw EEG reading where there is an upward and downward waveform. As reported, we were able to obtain very clear readings that day.



Grace's brainwave patterns in 2006 after one year of TTouch show overall calming, a predominance of slower frequencies

More About TTouch

According to Linda Tellington-Jones, the intent of TTouch is to awaken the cells' memory of perfection (perfect function) and to allow the body's ability to heal itself. This system of non-habitual touch is believed to activate unused neural pathways and even create new, more complex neural connections within the body and the mind, to sharpen awareness, mind body integration and the ability to learn new information. These are the specific benefits for each individual, however the improved connection, communication and empathy that develops amongst users of TTouch gently brings about peaceful relationships, too.

The reaction to TTouch appears to be universal across species. Linda Tellington-Jones didn't have to develop different techniques to teach horses, whales, snakes, parrots, cats, and dogs, etc. TTouch works for all species. Through touches that are universally understood, Linda and her students of TTouch, invite their animals to participate in harmonious mutual communication; cell to cell and heart to heart. In her book, The Tellington TTouch, Linda states: "Instead of seeing the TTouch as something that I do to animals, which would create separation between us, I view the circles as a way to come into cellular harmony with them, a way of allowing my cells to speak to theirs. At a cellular level, no living thing is alien to any other, and so the sense of connections remains the same whether I'm working with a gerbil or a lynx, a kitten or an elephant."

In the paragraph above, Linda Tellington-Jones is describing the potential for a kind of mutual communication at the cellular level that brings about cellular healing and harmonious relationships among beings. I believe that this deep non-verbal synchronous connection reminds us that well-being is our true nature and that well-being is the natural state of healing. One person or being can provide the spark that initiates the awareness of the potential for balance in another. This is considered true in my field psychotherapy, and the awareness of the potential for this balanced state is mutually created by the client and the therapist and is called the holding environment. For TTouch, the potential for the awareness of this state of natural balance is promoted through the making of the circles themselves affecting the giver and receiver simultaneously. The holding of the healing intention - for the cells to remember their perfection – allows the giver and receiver to let go of any pressure to solve the problem or to be "the healer" and it encourages each to rest into the body's wisdom and allow the body to find its natural state of balance.

One of my psychotherapy heroes, C.G. Jung, said that many of our personal and social problems arise when we become separated from our true nature due to the demands of modern life. In this loss of connection to our core sense of self, there is a kind of forgetting or loss of trust in this innate capacity to heal oneself. This situation is particularly true for our horse partners where the demands of modern life mean domestication and subjugation to their owner's needs. Domestication places requirements upon the horse that couldn't be farther from the horse's true nature, and may be the cause of many issues that arise between horses and their owners today. Linda Tellington-Jones developed her methods to help heal the relationships between humans and horses, and now this healing has spread to include humans and many species of animals, by improving interspecies communication through this method that teaches trust and body awareness for all beings engaged in its practice. Both the practitioner and the animal benefit from the mutual communication and gently remember and re-experience their innate potential for balance, wholeness and healing.

Holding The TTouch Intention

As recommended by Linda Tellington-Jones, I did not worry about accomplishing a particular set of exercises or TTouches during any of my visits with my horse. I tried any of a number of TTouches that came to mind for the day or a new one that I wanted to explore. I only participated in TTouch when I felt interested in doing so and when I could enjoy the TTouch without feeling hurried by a schedule. I focused my emotions on my love for my horse and my desire for her to heal both emotionally and physically. Additionally, I focused my intention on the cells under my hand that I visualized aglow with a healing blue-green light. I focused my thoughts on my belief in the body's innate intelligence and ability to heal itself, cell by cell.

Sometimes, I visualize the healing light spreading through my horse's entire body from the area where I am working. As instructed at a workshop by Linda Tellington-Jones, I often direct the intention for cellular healing under my hand calling for the cells to "Remember their perfection." And so began my exploration into the harmonious mutual communication with my animal partner, cell to cell and heart to heart. I visited Grace twice daily. TTouch sessions varied in length from a few minutes up to an hour.

TTouch and The Awakened Mind

Anna Wise and Linda Tellington-Jones previously studied brain wave activity in horses undergoing Anna's specialized training techniques using the Mind Mirror, a special machine that measures EEG activity. These studies suggest that horses move into an awakened mind state when training with Tellington Touch techniques. The Awakened Mind reflects a state of balance and optimal functioning that is expressed in a particular balance of delta, theta, alpha and beta brainwaves. Enhanced intuition, creativity, insight and spiritual awareness can occur. The body is relaxed and the mind is alive and capable of learning with ease.

When Linda Tellington-Jones and Anna Wise evaluated groups of horses in 1984 and 1985 at the Boulder Institute of Biofeedback they found that the basic resting state of the horses was primarily theta and delta with occasional flares of alpha. When TTouch was administered they saw an activation of delta, theta, alpha and beta categories of brainwaves in the horses similar to the awakened mind state. Tellington-Jones and Wise reported that alpha was consistently activated during TTouch, as well as some beta.

As described by Linda Tellington-Jones, the horse that is working in the awakened mind state learns more quickly and is safer to ride because the horse's capacity to think helps it to override primary instincts to flee in novel or startling situations. Training time is reduced, and no mindless repetition or forceful methods are ever used. The TTouch approach is unique in its focus on learning through movement and touch, specifically slow and gentle movement of the body. The slow pace of TTouch movement is intentional. Slow movement is not the norm, and so the novelty of the slow movement captures attention, awakens the brain, increases focus, encourages quiescence and uses different muscles and neural pathways than when rapid movement is employed. Horses can learn new skills more effectively and with ease through non-habitual movements that are believed to activate the development of unused or even new neural pathways.

Changing Behavior Through TTouch

Grace had a hard time separating from her old life of 15 years with one owner and settling into her new environment at our barn. Her left hip was very tight, and she was rock bottom of the pecking order in her field. Grace's anxiety and pain showed up behaviorally as rushing, which could spiral out of control.

In spite of our good intentions I, like many other horse enthusiasts, fell into a pattern of pushing my horse beyond her emotional and physical comfort zone. This was before I understood that she was suffering from both an emotional adjustment problem and a suspensory ligament injury.

We had Radiographs taken which are x-rays with added dye for clarity. These showed developing arthritis in all fetlocks. And, an upper suspensory ligament separation in the left forehand was found using ultrasound techniques. We were instructed to keep Grace in a stall full time for six months. While the news was upsetting, it made sense that Grace's rushing was, at least in part, due to physical pain. But, Grace's rushing had also become habitual, and we did not know how long these patterns had been present.

Sandy Rakowitz a TTouch/TTEAM Practitioner taught me about Linda Tellington-Jones and TTouch. I began to understand that Grace's injuries and pain were influencing her personality and behavior. With Sandy's guidance, Grace and I were introduced to many TTouches that we worked into Grace's daily grooming routine during her six months in the stall. I wanted to use TTouch to develop a more trusting relationship with Grace, relieve her of pain and test the claims that TTouch could even change a horse's personality.

The TTouch Program

For those unfamiliar with TTouch, I have included pictures in the appendix of the touches and groundwork included in my yearlong program. Detailed explanations are available in many of Linda Tellington-Jones's books listed in the bibliography.

The TTouches included: Lowering the Head, Python Lifts, The Lick of the Cow's Tongue, Ear Work, Tail Work and the Leg Work. Following my attendance at Linda's workshop in April 2005, new TTouches and various forms of ground work were added to increase calming of the limbic system, improve balance, self-confidence, promote flexibility and reduce pain. Light Raccoon TTouch was added to the leg work, especially around the injuries and arthritis combined with therapeutic grade lemongrass essential oil for tendons and ligaments, lavender for muscle tension, peppermint for cooling and swelling and lemon for circulation. Grace developed a pattern of avoiding touch to her left front leg as a result of the pain from her injury. She needed to learn that she was now able to tolerate gentle touch without anxious anticipation on her part.

Grace developed a pattern of rushing in part as a reaction to the pain. A sense of safety and containment were encouraged through the Journey of the Homing Pigeon, a two person leading position that 'activates' both sides of the horse's brain, increasing focus and concentration.

Leading Grace through The Labyrinth using the wand and a variety of leading positions encouraged patience, obedience, focus, balance and self-control.

Taming the Tiger was added to help Grace learn to stand patiently while being groomed in the stall.

Mouth Work was added to calm the limbic system, as tension from an active limbic system could be seen in the pursing around her mouth forcing her nose and lips into the shape of a parrot's beak. This description of the relationship between the limbic system and the mouth are explained a many of Linda's books, tapes and videos.

EEG Assessment Procedure To Evaluate The Immediate Impact of TTouch During Stroking

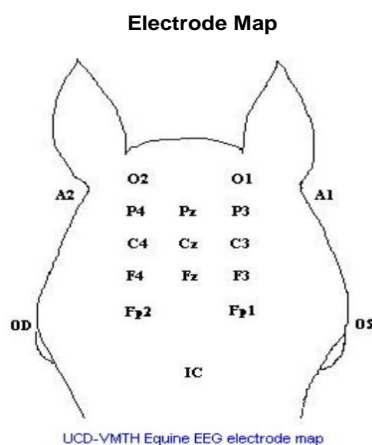
Sandy Rakowitz, Jessica Eure and I assessed TTouch with Grace, my Morgan mare who was 15 years old at the time, using the Pendant, a portable EEG device developed by Pocket Neurobics and a laptop. Five pairs of sites were assessed to include the horse's left and right frontal lobe (F3, F4), left and right sensorimotor cortex (C3, C4), the frontal midline and the occipital lobe (Fz, Oz), the left and right parietal lobe (P3, P4) and the left and right temporal lobe (T3, T4).

Electrodes were placed on Grace's head and attached to the wireless communication device used to transform the raw EEG into a signal the computer could record. At each site, a three minute test was performed. The EEG recordings were very clear with no electromagnetic interference because we were located at farm in a rural community outside of Charlottesville, VA where other electronic or wireless signals were not detectable.

The entire EEG assessment procedure took almost an entire workday. During this time, Grace tolerated standing quietly while electrodes were applied to ten different sites on her head. I think we ran 12 different tests to obtain the 5 clean sets of three-minute tests. The electrode wires were often visible to the horse because we used 3-foot long 10 mm gold disc Grass brand electrodes with a central hole. Grace often shook her head and flicked her ears throwing off the wires and electrodes in an attempt to keep the multitude of flies at bay. There were quite a few repeated applications of electrodes and aborted three-minute tests for this reason. It was hot at the barn in June. We were completely exhausted by the end of the day, and only then realized what time and effort would be necessary for our follow-up assessments!



Grace is relaxing into the stroking of her chest during a three minute test.



Position of Electrode Placement: F = frontal lobes; C=sensorimotor cortex; P= parietal lobes; O= occipital lobes; A = temporal lobes and reference points.

The TTouch wand used for stroking looks like a 4-foot training whip or long crop. It is beautifully balanced and comfortable for the practitioner to hold. Linda describes the wand as an extension of the hand used to contact the horse. The wand brings the horse's attention to locations on its body that would ordinarily be inaccessible to the practitioner without moving in closer to the horse or moving around to the opposite side. For example, it is possible to stroke the outside of the right shoulder while standing on the left side of the chest.

When stroking with the wand, enough pressure is applied so that the wand gently presses and bends against the horse's coat, producing a firm and soothing touch, much like stroking by hand. Slow, methodical stroking is intended to be reminiscent of early maternal licking and grooming which animals across species find soothing. We expected to find that Grace's EEG would show evidence of relaxation and calming during stroking and as previously mentioned, a predominance of delta, theta and alpha waves as seen in the Mind Mirror studies of 1984 and 1985 at the Biofeedback Institute of Colorado.

The Three-Minute Test

The following is a description of the three-minute tests.

1) Standing Quietly for Minute One

Grace stood in her stall facing away from the door to decrease outside interest. Sandy Rakowitz, the handler, Robin Bernhard, the electrode manager, and Jessica Eure, the computer manager, stood on Grace's left side, quietly without moving during all tests. The handler stood a few feet away from the horse, but within reach of her front and hind using the wand to keep excess movement to a minimum.

2) Stroking Pattern for Minute Two.

The stroke started at the throat latch, continued down the front of the neck, down the front of the chest and then down the legs to the hooves.

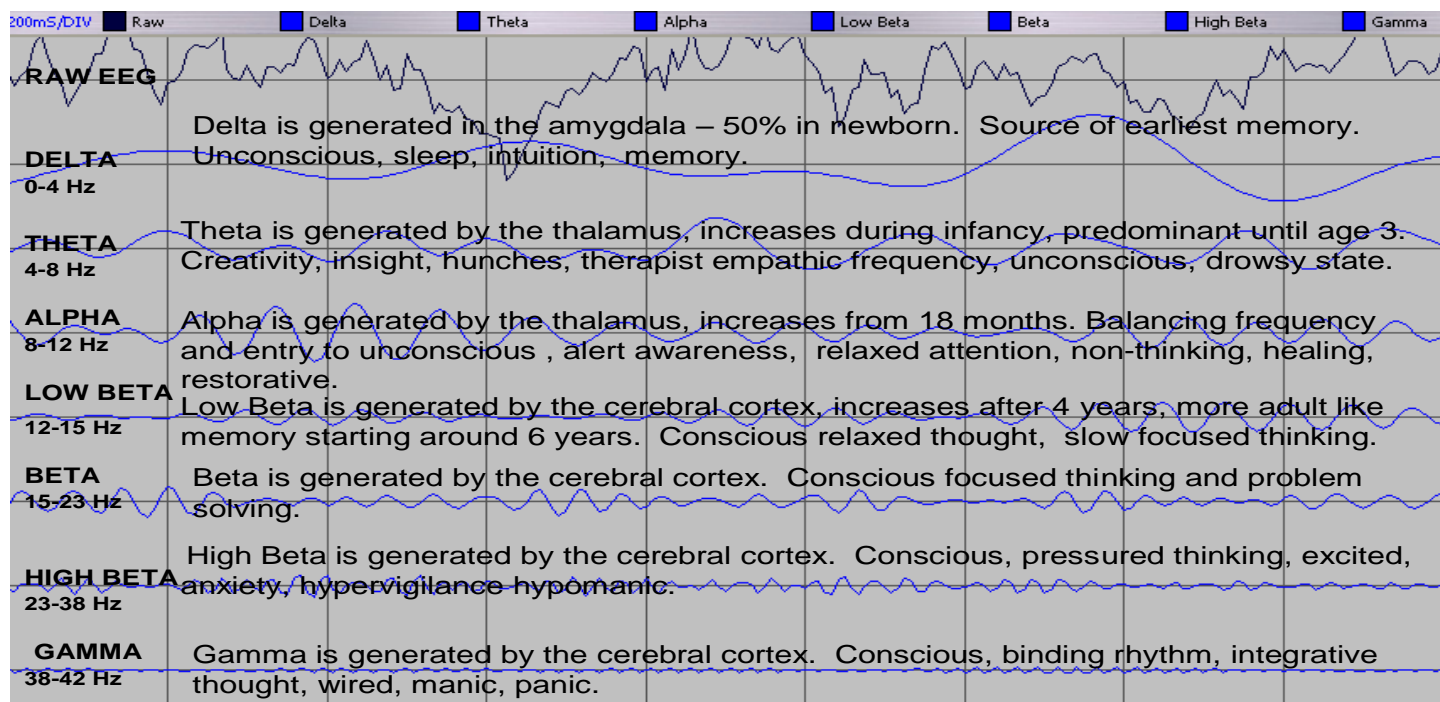
3) Stroking Pattern for Minute Three.

The stroke started at the withers, along the spine, over the croup and down the hind legs to the hooves as well.

Interpretation of the Immediate Effects of Touch Recorded by the EEG Assessment

A brief review of the various brainwaves and their functions should help readers to make sense of the results of the EEG assessment. The EEG is a graphic representation of the electrochemical discharge from neurons that are actively sending information. The sizes of the neural impulses are measured in microvolts and the speeds of the neural impulses are measured in cycles per second from 0-48 Hz. The brainwaves with a slower frequency come from the more primitive brain structures and the brainwaves of faster frequencies are generated by the cerebral cortex during thinking. The chart below called the "The Appearance of the EEG" describes the shape and function of the different brain waves.

The Appearance of the EEG



Virginia Neurofeedback Attachment and Trauma Center
BioExplorer Files. Synthesis from work of Wise and Van Deusen,

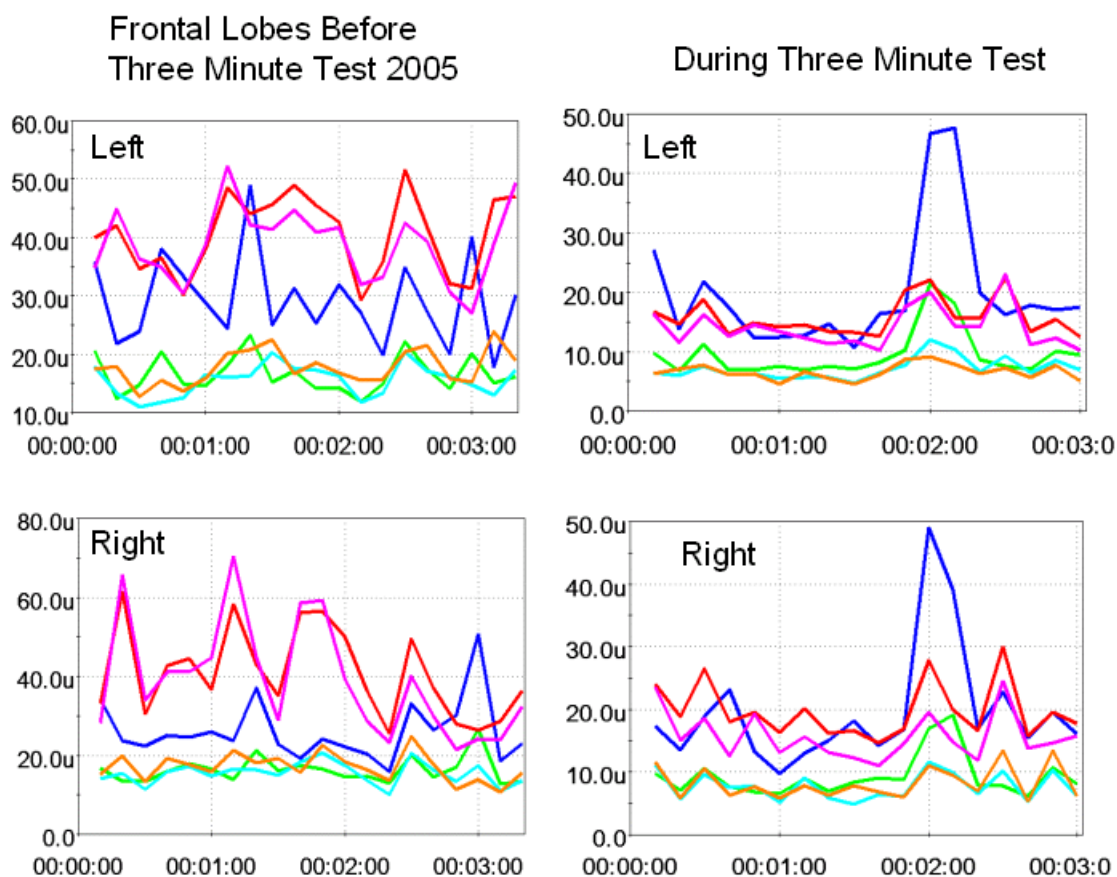
The EEG assessment provides a picture of the energetic balance in the brain, at rest and during the stroking. I have taken the liberty of interpreting the assessment of my horse in a manner similar to how I would interpret a human EEG keeping in mind the following: 1) The horse has a minimal corpus collosum to connect the left half and right half of the brain so that the left and right hemispheres are believed to function rather independently of one another, 2) I am aware and careful not to make unreasonable anthropocentric assumptions about what "horse thinking" might entail. I can however, make accurate measurements about

levels of activity at the sites tested how these activity levels and brainwave patterns might affect behavior. I can accurately identify shifts in activity levels of the EEG change over time.

Material from the three-minute tests were used in two ways: 1) all of the information from the five three-minute tests were pooled using BioExplorer software by CyberEvolution, Inc. and The Learning Curve EEG Assessment in Excel developed by Peter Van Deusen to generate a report of the horse's entire brain at rest and during stroking and 2) the raw data from each test was averaged, graphed and evaluated for evidence of brainwave reactions at rest and stroking. Each of the paired brain sites had to be tested independently using 5 electrodes at one time, so the brain maps are a compilation of 5 three-minute tests taken at different times through out the entire day.

The Frontal Lobes:

We did not find the predominance of delta, theta and alpha frequencies seen in the previous horse studies. What we found were very high amplitudes throughout the brainwave spectrum with a heavy load of very fast frequencies. At rest, Grace's brainwave pattern in the frontal lobes suggested that she was in a state of extreme distress, something like an acute stress response. At rest, Grace's right frontal lobe showed more activation in the faster thinking speeds than the left, a pattern associated with low impulse control, anxiety, agitation in humans. We took a baseline reading before our warm up stroking practice for the assessment. We quickly stopped practice for the 3-minute tests when we saw the calming effect the stroking had by reducing size or amplitude of the brainwaves. The image below shows the left and right frontal lobes before stroking and the left and right frontal lobes after three minutes of stroking with the wand.



The images show the changes in the brainwave patterns before and after stroking for three minutes in June 2005. The average amplitude decreases demonstrating an overall calming of the EEG. In the images on the left side, beta and hibeta predominate while delta actually predominates after only a few minutes of stroking. Delta=dark blue; Theta=green; Alpha=light blue; Lobeta=orange; Beta=red; Hibeta=pink.

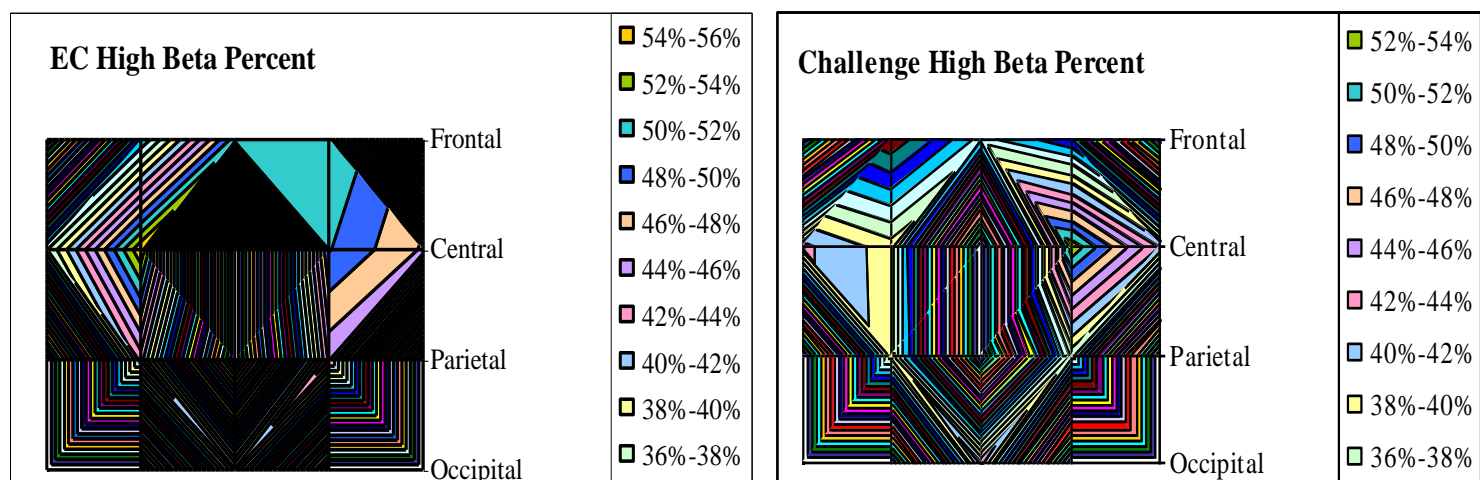
Hypervigilance associated with hibeta brainwave activity was noted during resting. While resting, hibeta activity was found to be greater in the right frontal lobe, an indicator of anxiety and impulse control issues. After stroking, the hibeta activity reduced in the right frontal lobe and increased in the left frontal lobe, a pattern associated with sequential thinking in humans. The beta activation in the left frontal lobe while the horse was attending to the sensations created by being stroked with the wand was considered suggestive of “horse thinking.” This finding of increased beta, especially in the left frontal lobe supports the earlier work by Anna Wise and Linda Tellington-Jones in 1987 and 1988.

The Sensorimotor Cortex

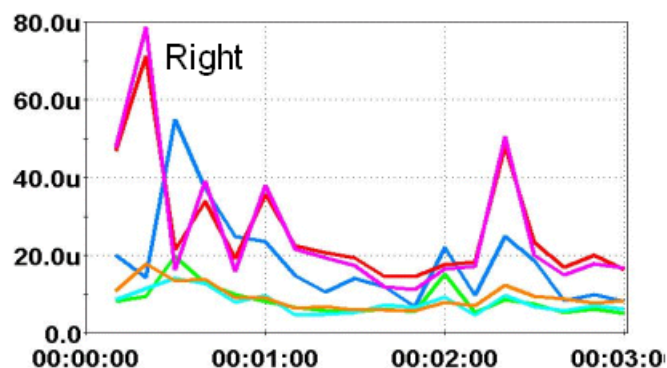
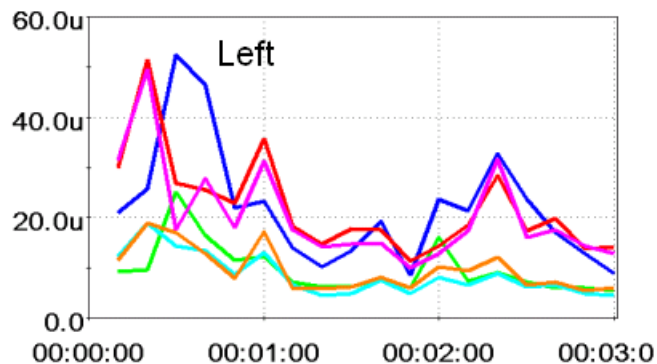
In humans, the right sensorimotor cortex is known for relaxation, enhanced body awareness and a sense of feeling safe inside one’s skin or vice versa, for pain and tension when high frequencies are overly active. Grace’s assessment appeared to suggest that tension in the body was a problem because her assessment showed very high amplitudes of beta and hibeta activity in the right sensorimotor cortex while she was standing at rest. In the past, before TTTouch, Massage had been used to address bodily tension in Grace. Muscular tension was evident in the mare’s body, and I believed that this tension was partially responsible for pain and muscular restriction that made it difficult for her to maintain her balance while performing particular movements. Sometimes a horse will become frightened when balance is compromised due to pain or muscular restriction and rushing will be the a symptom of this problem.

Interestingly, beta and hibeta frequencies decreased in the right sensorimotor cortex when she was being stroked. This is a change in brainwave patterning that is understood to be associated with increased relaxation and a sense of calm in the body with humans. In fact, the center of a bull’s eye pattern indicated a slowing of activity in the right sensorimotor cortex, located at C4. This is a specific site that is used in neurofeedback to enhance mental focus and calmness in the body. I concluded that Grace experienced reduced tension in her body during stroking and with this reduction in tension an increased ability to focus.

The images below show a cross section of the horse’s brain looking down from a bird’s eye view. The image on the left shows the hibeta brain map before stroking. The darker color in the right frontal lobe and sensorimotor strip(Located where?) shows more hibeta activity in this area at rest suggestive of anxiety, impulsive behavior and tension in the body. The image on the right shows shifts in hibeta activity after stroking for two minutes. The left frontal lobe is now more active with calming in the right frontal lobe and both left and right sensorimotor cortex. This pattern suggests that the immediate effect of the TTTouch stroking is to activate the left frontal lobe and to calm the right frontal lobe and sensorimotor cortex, a pattern suggestive of a calm, relaxed body and a focused mind.



The Sensorimotor Cortex During Three Minute Test 2005



The graphs above show the calming of the sensorimotor cortex during the three minute test. Delta=dark blue; Theta=green; Alpha=light blue; Lobeta=orange; Beta=red; Hibeta=pink.

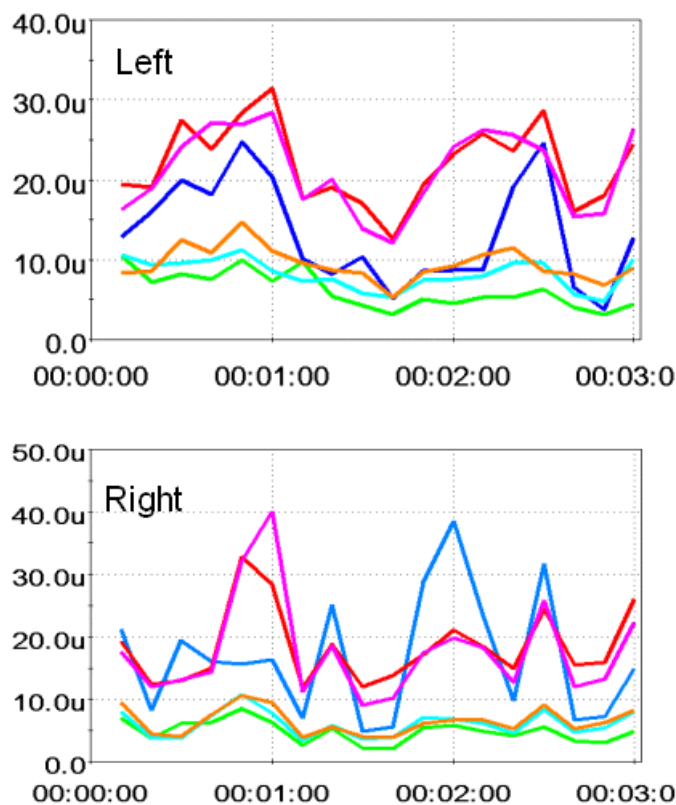
The Parietal Lobes

The parietal lobes are association center, meaning that sensory input is filtered through the thalamus and parietal lobes where this information is assimilated into a whole image or concept before being sent to the frontal lobes. The right parietal lobe is more involved in sensory and proprioceptive information while the left parietal lobe is more involved in left-right orientation and mental tasks, in humans. Our EEG assessment did not show overall quieting during the stroking as we expected. It appears that stroking with the wand engages the parietal lobes differently from the other parts of the brain.

The left and right parietal lobes were actively engaged during stroking. Stroking uses gentle touch over the horse's body with the intention of increasing proprioceptive and interceptive awareness to the parts of the body being stroked. (Give examples of what this means) It appears that this simple TTouch activated both parietal lobes, especially in the faster frequencies. Some indication of increasing calm in the body showed as greater delta amplitudes in the right parietal lobe, however, the continued activation of beta and hibeta during stroking suggests that these integrative centers associated with body awareness and spatial orientation were busy in the "thinking speeds" during stroking. TTouch is intended to develop confidence and agility through body awareness.

If TTouch improves sensory integration by activating the parietal lobes, a horse receiving TTouch might have a better three dimensional image of itself in motion and enhanced kinesthetic knowledge of where its body is located or needs to be located to perform well. Enhanced body awareness could make the learning of new skills that require these senses easier.

The Parietal Lobes During Three Minute Test 2005



This graph of the parietal lobes during the three minute test shows that the brain remains more active during stroking than at the other areas that have been tested. The right parietal lobe calms in the thinking speeds but the left parietal lobe continues to stay active in the thinking speeds of beta and hibeta. In humans, the left parietal lobe works more on left-right orientation while the right parietal lobe is engaged in sensory awareness. The purpose of stroking with the wand is to assist the animal to become aware of the edges of its body in 3-D. It appears that stroking may be activating the part of the brain that could be involved in left-right spatial orientation.

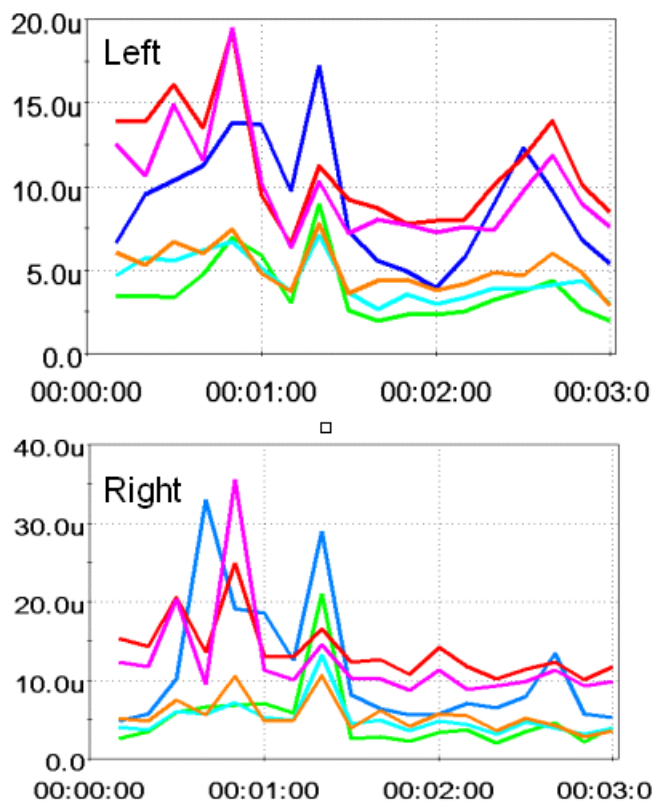
The Temporal Lobes:

The temporal lobes are involved in the fight/flight, bonding and pleasurable primitive instinctual responses. In humans, the right temporal lobe is related to emotional and sensory memory which records how an experience is 'felt.' The left temporal lobe is associated with the actual sequence of events, providing a narrative of what happened without the emotional or sensory information.

Grace's EEG assessment showed elevated fast frequency activity in the temporal lobes during the first minute of resting. This over activity during the resting state is suggestive of limbic overdrive; a limbic system that is responding to the environment with fear. A horse with this pattern in the limbic system, is more likely to perceive the world as dangerous, have a tendency to react out of fear and be unable to mediate instinctual responses. In humans we refer to this pattern of reactivity as PTSD. In a horse, like Grace, temporal over activity might set the stage for a fear response that builds upon itself, as we had seen many times when Grace would want to move faster and faster and could not settle herself down. The patterning of the limbic system overdrive at rest was similar to the patterning found in the frontal lobes.

During stroking, both temporal lobes showed greatly reduced activity, with the largest drop in beta and hibeta frequencies, a pattern associated with emotional calming. I concluded that the stroking did induce limbic calming and was probably felt as such by the horse. When the limbic system becomes calm, the entire brain becomes more calm.

The Temporal Lobes During Three Minute Test 2005



The three minute test shows calming in both temporal lobes. In the state of “rest” the hibeta activity in the right temporal lobe is practically twice that in the left temporal lobe which is suggestive of a trauma response. Grace was standing quietly and there would have been no way for us to know by her behavior that she was so over stimulated. Calming in the right temporal lobe occurred within 30 seconds of stroking. Apparently, this brief time spent stroking can make an enormous difference for the comfort of the animal.

Long-Term Effects of the TTouch and TTEAM Program Seen in the Equine EEG

Grace’s EEG was assessed one year after our initial assessment and again at 1 year and 2 months.

Unfortunately, due to computer problems, I could not use the entire assessment for comparison as we had planned. Luckily, we were able to compare changes in Grace’s frontal lobes over time. These assessments clearly demonstrate the value of a long-term integrated TTouch program. For example, the initial hibeta frequencies that I believed to represent the hypervigilant, anxiety patterns averaged as high as 79 microvolts. One year later, the hibeta in the frontal lobes averaged 14 microvolts. Two months after that in August of 2006, the hibeta in the frontal lobes averaged just over 5 microvolts. At this point, Grace’s EEG no longer had the appearance of PTSD.

I used well-researched EEG markers to compare Grace’s brainwave changes over time. I will openly admit that my EEG equipment measures many more variables than I have reported here. I hunted through many measurable variables before deciding which to include in this article. While the ‘hunting’ technique is not considered admirable in research, with no literature out there that addresses equine EEG markers that can be correlated to observable equine behaviors, I felt that I needed to proceed with an open mind and choose basic easily measured and understood markers for my paper. I chose to compare the change in amplitudes and

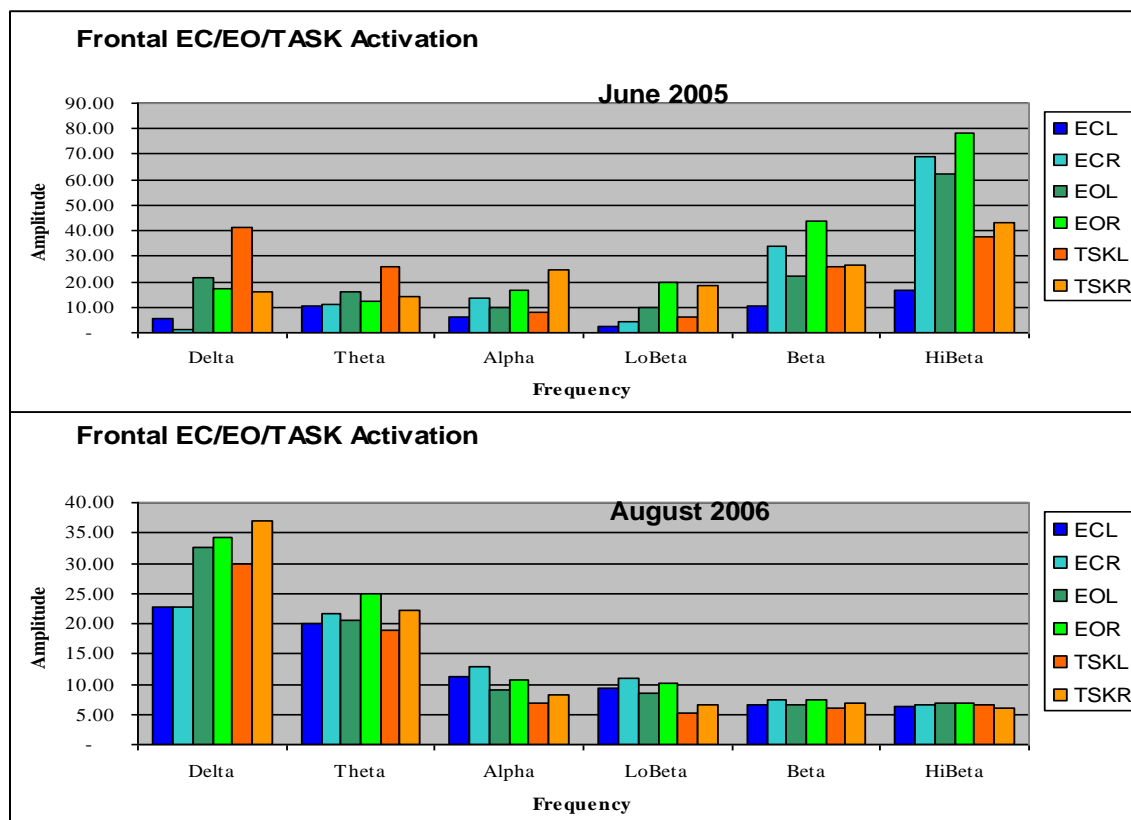
percentages in all frequencies found in the left and right frontal lobes from June 2005 to August 2006, the changes in the theta/beta ratio from June '05 to August '06 and the change in the peak alpha frequency in the frontal lobes from June '05 to August '06.

The Change in Amplitudes of All Frequencies in the Left and Right Frontal Lobes from the Initial Assessment in June 2005 to the Final Assessment in August 2006

The histograms below show the amplitudes of all frequencies measured in microvolts across the EEG spectrum from 1-39 hertz during the three minute tests of the frontal lobes in 2005 and 2006. The resting state is shown in blue. The stroking of the chest is shown in green and the stroking of the hind in orange. The amplitudes of the left frontal lobe are shown in the darker shade of each color and the right frontal lobe in the lighter shade of each color.

The uphill pattern of the histogram of the frontal lobes during the three minute test in 2005 indicates there was a predominance of fast frequencies, representing an anxious state. The amplitudes in the left and right frontal lobes were not balanced. A look at the second histogram shows a downhill pattern that indicates a predominance of slower frequencies. The activation pattern in the frontal lobes had completely changed over the course of the year. Initially, Grace's hibeta (anxiety) frequency showed the greatest amplitude of all frequencies with slightly more activation in the right hemisphere suggestive of anxiety and impulsivity. In August of 2006, Grace's EEG showed additional slow frequencies, representing a calmer state. Grace did not need to over ride her fear based instinctual responses because they simply did not develop as they had in the past. These results suggest the calming and centering effects of TTouch training produce significant shifts in brain wave patterns that parallel observable behavioral changes.

Comparison of Grace's Frontal Lobes



Changes in the amplitudes of all measured frequencies in the left and right frontal lobes from June 2005 to August 2006

The amplitudes in all the frequencies the frontal lobes during three minute test in June 2005

Left	Rest	5.41	10.63	6.37	2.56	10.48	16.72
	Front	21.79	16.30	9.97	9.73	22.13	62.30
	Back	41.01	25.74	8.06	6.18	26.10	37.79
Right	Rest	1.45	11.08	13.28	4.14	34.21	68.83
	Front	17.54	12.33	16.83	20.01	44.02	78.15
	Back	16.08	14.19	24.44	18.57	26.82	43.26
		Delta	Theta	Alpha	Lobeta	Beta	HiBeta

The amplitudes in all frequencies in the frontal lobes during three minute test in August 2006

Left	Rest	22.75	19.99	11.36	9.36	6.53	6.22
	Front	32.74	20.57	8.92	8.48	6.57	6.87
	Back	29.83	18.96	6.80	5.33	6.15	6.65
Right	Rest	22.74	21.57	12.94	11.01	7.49	6.45
	Front	34.19	24.83	10.76	10.01	7.51	6.75
	Back	36.85	22.18	8.13	6.56	6.72	6.11
		Delta	Theta	Alpha	Lobeta	Beta	HiBeta

The Change in Percentages of All Frequencies in the Left and Right Frontal Lobes from the Initial Assessment in June 2005 to the Final Assessment in August 2006.

For optimal functioning in humans, we look for a particular balance in the percentages of brainwaves between the left and the right frontal lobes across all of the frequencies. There should be almost equal, but a slightly greater percentage of the slower frequencies (delta, theta and alpha) in the right frontal lobe which indicates a state of calm in the body and an ability to inhibit unwanted or impulsive behavior. There should be an almost equal but slightly greater percentage of thinking speeds (lobeta, beta and hibeta) in the left frontal lobe compared to the right frontal lobe that indicates the slight dominance of logical or sequential thinking in humans. In horses, this ideal pattern for brain wave balance and optimal functioning occur when the horse demonstrates the ability to be patient and to wait for direction and to inhibit impulsive fear driven responses when frightened or surprised.

The percentage of delta and theta frequencies in Grace's frontal lobes increased from June 2005 to August 2006. The increase in the percentage of the delta and theta brainwaves was much greater comparatively in the right frontal lobe. This increase in the slower frequencies in the right frontal lobe supports the observations that Grace was not able to mediate her impulsive behavior in June of '05 and was much calmer and more able to mediate her impulses by August of 2006. The delta and theta balance between hemispheres was severely out of balance in June of '05 and is much closer to optimal in August of '06 following one year of TTTouch.

Interestingly, Grace's alpha percentages were low in both assessments, but showed improved left hemisphere to right hemisphere balance in August 2006 following our TTTouch program.

The three thinking speeds (lobeta, beta and hibeta) show some interesting shifts in the percentages between June 2005 and August 2006. Lobeta is one type of thinking speed. The percentage of lobeta brainwaves is greater in the left and right frontal lobes in August 2006 suggestive of more activity in this slow thinking speed. The percentage of beta brainwaves was lower in August 2006 suggestive of less activity in this moderate thinking speed. The percentage of hibeta brainwaves dropped dramatically in August 2006 suggestive that fast thinking brainwaves (often associated with impulsivity and/or anxiety) had decreased after one year of a

TTouch program. All three thinking speeds show improved left hemisphere to right hemisphere balance at the end of the year-long TTouch program.

The above measurable results support behavioral changes that we observed before and after the TTouch and TTEAM program. All of the frequencies in Grace's frontal lobes showed a much healthier balance between the left hemisphere and right hemisphere. Most notably, the right frontal lobe showed the greatest increase in the delta and theta percentages suggestive of a calmer bodily state. The dramatic decrease in beta percentages and a healthier left hemisphere to right hemisphere balance in all of the thinking speeds is suggestive of less anxiety, less tension in the body and an increased ability to manage instinctually based or impulsive behavior. The increased relaxation in Grace's muscles was evident in her posture and her improved balance when ridden. She was no longer easily frightened or unusually impulsive and was eventually ridden without a bridle.

	L Frontal Lobe		R Frontal Lobe	
	Jun-05	Aug-06	Jun-05	Aug-06
	L Delta Percentage		R Delta Percentage	
Rest	10.4	22.5	1.1	18.2
Stroking Front	15.3	19.9	9.3	23.6
Stroking Hind	28.3	22.5	11.2	22.7
	L Theta Percentage		R Theta Percentage	
Rest	20.4	21.5	8.3	19.9
Stroking Front	11.5	22.6	6.5	19.7
Stroking Hind	17.8	20.4	9.9	20.6
	L Alpha Percentage		R Alpha Percentage	
Rest	12.2	12.4	10.1	11.1
Stroking Front	7.1	12.7	8.9	12.7
Stroking Hind	5.6	10.5	17.1	10.5
	L Lobeta Percentage		R Lobeta Percentage	
Rest	4.9	11.1	3.1	10.6
Stroking Front	6.8	12.4	10.6	10.5
Stroking Hind	4.3	8.9	8.9	9.1
	L Beta Percentage		R Beta Percentage	
Rest	20.1	14.1	25.7	17.3
Stroking Front	15.6	13.8	23.3	14.9
Stroking Hind	18.1	15.1	18.7	15.1
	L Hibeta Percentage		R Hibeta Percentage	
Rest	32.1	18.5	51.8	23.1
Stroking Front	43.8	18.7	41.4	18.6
Stroking Hind	26.1	22.1	30.2	22.1

Chart of The Change in Percentage of All Measured Frequencies in the Left and Right Frontal Lobes from June 2005 to August 2006

Theta/Beta Ratio

Neurotherapists look at the theta/beta ratio to determine the presence of a problem with the screening of incoming and outgoing information. When there are problems with the management of the interface between the inner and outer worlds, the inability to effectively understand incoming information will result in behavior symptomatic of distress, confusion or over stimulation. People with screening issues say that they struggle with: distractibility, poor sleep, teeth grinding, impulsivity and unstable/angry emotional outbursts, or agitation when over stimulated. A horse with this issue would be reactive, have difficulty understanding requests and may respond with confusion and agitation or opposition.

The theta/beta ratio expresses the relationship between the slow, dreamy thinking of theta to the fast, sequential or linear thinking of beta. Theta and beta should be present at any one site in equal proportion. A balanced theta/beta ratio permits a flexible exchange of information between the inner and the outer worlds. When the

theta to beta ratio is higher than one, a dreamy state takes precedence over linear thinking. The focus is more internalized and disconnected from the outer world. When the theta/beta ratio is below one the fast linear thinking predominates and the focus is on the outer world and the information that is coming from the outer world. When the theta/beta ratio is very low, or closer to zero, agitation, distractibility and impulsive behavior may predominate.

The frontal lobe assessment in June shows theta/ beta ratios of less than one, except in the left frontal lobe during rest. This is not true in August of 2006, where all the theta/ beta ratios are greater than one. Theta/ beta ratios greater than one indicate there are more slow thinking theta waves than fast thinking beta waves in both the left and right frontal lobes at rest and during stroking. I believe that this increase in theta/ beta ratios from June 2005 to August 2006 is the measurable evidence that a long term TTTouch program produces cumulative affects of calming and re-balancing brain wave patterns. A TTTouch program can help to remind the body of its natural state of balance. These results support what we observed in Grace's behavior. She was able to take in information and respond without becoming over stimulated and impulsive like she had been in the past.

THETA/BETA RATIO = 1

	Left Frontal Lobe		Right Frontal Lobe	
	Jun-05	Aug-06	Jun-05	Aug-06
Rest	1.01	1.52	0.32	1.15
Stroking Front	0.74	1.64	0.28	1.32
Stroking Hind	0.99	1.36	0.53	1.37

Chart of the increase in the theta/beta ratio in Grace's frontal lobes from June 2005 to August 2006

Peak Alpha Frequency

In humans, slow alpha, 8-10 hertz, is present during a state of internalized focus commonly seen with certain types of meditation. Fast alpha, 11-12 hertz, has been called the peak performance state observed in highly focused athletes performing well rehearsed movements using broad "open awareness" and alert attunement to the environment. While fast alpha does not represent a thinking speed, it is indicative of heightened awareness as would be needed for peak performance. Fast alpha in the frontal lobes is associated with anxiety in humans, and an alpha speed averaging about 10 hertz is considered ideal. The left frontal lobe does not show much change in the peak alpha frequency between our assessment in June 2005 and August 2006, and the peak alpha frequency is already pretty close to ideal in both assessments. There is a large decrease in the peak alpha frequency in the right frontal lobe from June 2005 to August 2006 suggestive of calming. Fast alpha, between 11-12 hertz, is associated with anxiety when found in the frontal lobes. I believe that this shift downward in peak alpha frequency in the right frontal lobe indicates that Grace is calmer in August 2006 than in June 2005.

PEAK ALPHA FREQUENCY

	Left Frontal Lobe		Right Frontal Lobe	
	Jun-05	Aug-06	Jun-05	Aug-06
Rest	9.91	10.81	12.15	11.03
Stroking Front	10.97	10.83	12.49	10.94
Stroking Hind	10.53	10.84	12.51	10.84

A decrease in peak alpha frequency, especially in the right frontal lobe

Conclusion and Future Implications

TTouch stroking with the wand produced observable signs of calming within minutes such as: licking and chewing, drooping of the head, drooping eyelids and a softening of the muzzle. The EEG measurements provided objective information to confirm that these indicators did occur when the brain wave patterns are slower with less variability and less amplitude. In addition, the EEG demonstrated that the horse's intense anxiety was not always visible to the eye. This is extremely important for equine enthusiasts to know. Horses are known for their 'quick responses and explosive' behavior. In actuality, it may be a truer picture that the handlers have not known the intensity of the energy brewing under the surface. It was very disturbing to see that my horse had intense levels of anxiety when standing 'calmly' in the stall. This information helps to explain why she could seem to be so easily triggered into a flight state.

In summary, the frontal lobes, which are for decision-making and sequential reasoning in humans, showed some calming and increased beta or 'thinking' activity during stroking. The sensory motor cortex, which is responsible for voluntary muscle movements and body awareness showed changes reflective of calming in the body. In humans, sensorimotor calming permits an increased ability to focus. It is possible, that the same pattern could produce a similar result in horses.

The temporal lobes, which are responsible for overall nervous tension and sensitivity to danger, showed overall calming. The temporal lobes are particularly important because of the role they play in the development of PTSD. When disturbing or trauma based information remains stuck in the temporal lobes, all the symptoms of PTSD develop. Since the temporal lobes are like the gas peddle for the entire brain, calm temporal lobes assist in calming the entire brain. In humans, this reduction in limbic excitability is also associated with more fluid cognitive skills and improved memory. Cognition is more fluid without the disruption and distraction caused by anxiety or central nervous system tension.

The parietal lobes, which are responsible for sensory integration and the synthesis of incoming information into a whole concept or big picture, remained active during stroking. The activity already present in the parietal lobes during resting was interpreted as an overly active state of tension or anxiety while standing because such high activity was apparent in other parts of the brain. While the continued activation in this area during stroking might be interpreted as continued agitation, I felt this was not an accurate interpretation of the circumstances. Since the test sites were showing that relaxation was taking place during stroking we wondered if the continued activity in parietal lobes might actually suggest Grace's brain was responding with interest to the act of being touched.

The results from the initial EEG suggested that the equine electroencephalograph included higher frequencies than the typical human EEG. I wondered if the presence of higher frequencies, associated with sensitivity, intensity and hyperactivity was simply due to the sensitive equine temperament. The changes we have seen over the course of the year suggest that the equine EEG is not necessarily loaded with faster frequencies. Grace was reactive to her environment because she was internally agitated, possibly due to physical pain and emotional stress.

If we understand that central nervous system over stimulation is unpleasant for the animal and can lead to unwanted behavioral displays, we are less likely to punish the animal and less likely to label the difficult to manage behavior as an undesirable personality trait. If the horse is already responding to the environment as if with fear based reactions, it only makes sense to seek training methods that do not activate these habitual patterns further. These reactive, instinctually based responses indicate that the horse is riddled with fear or defensive aggression and unable to comply with a trainer's request. TTouch training techniques do not promote instinctual reactions but promote a state of balance through gentle, non-forceful strategies that calm the body and stimulate curiosity through unique sensory experiences.

Over the course of the year, Grace's personality shifted from frequently being agitated to being more serene. The brain wave spectrum also changed during this same time span. The cumulative and enduring shift in the frontal lobes from high amplitudes of fast frequencies to high amplitudes of slow frequencies was reflected in Grace's dramatic postural and behavioral changes. Most notably, the right frontal lobe showed the greatest increase in the delta and theta percentages suggestive of a calmer bodily state. The dramatic decrease in high beta percentages and a healthier left hemisphere to right hemisphere balance in all of the thinking speeds is suggestive of less anxiety, less tension in the body and an increased ability to manage instinctually based or impulsive behavior. The increase in theta/ beta ratios from June 2005 to August 2006 is more measurable evidence that a long term TTouch program produces cumulative affects of calming and re-balancing brain wave patterns. And the downward shift in peak alpha frequency in the right frontal lobe indicates that Grace was calmer in August 2006 than in June 2005.

Grace became calm and patient enough to wait and listen for direction while being ridden. She seemed very relaxed in most situations. She was easier to ride out on the trails and she rarely rushed the way she did in the past. Rather than sporting a 'giraffe neck,' Grace allowed her head to drop, even while being ridden. I believe that Grace finally learned that she was safe after a rough transition to our barn. Together, Grace and I developed a sense of trust through time spent in quiet connection that TTouch allowed. TTouch permitted us to move past our fear based reactions to each other and into a pleasurable, mutually satisfying relationship.

In closing, I want to mention how the heart rejoices in the development of these peaceful, harmonious relationships that are an outcome of TTouch. The healing emotions and the experience of becoming more in balance as the giver or receiver of TTouch seem to make room for a clearer relationship between the head and the heart. This particular article demonstrates that TTouch, at least in this case study, does show measurable evidence for calming and balancing the brain. And from my experience, it feels like the heart finds its center and becomes in sync with the brain through the language of TTouch. In the future we intend to continue this investigation and look into the relationships between TTouch and brain wave coherence, along with TTouch and heart coherence.

Appendix
Journey of the Homing Pigeon June 2006



Grace is led from both sides to offer structure and containment. Sandy uses the Dingo with a light tap, tap, tap and stroke on Grace's back to encourage her to move ahead.



We gently tap Grace's chest with the wands to signal "whoaaaa".



Grace drops her head, releases her back and swings her hips freely in a loose relaxed walk.

Working The Front Legs



Sandy performs TTouces on the sole of Grace's hoof. Sandy moves the fetlock, elbow and shoulder in circular motion to loosen the joints and bring proprioceptive and interoceptive awareness to the area.



Sandy continues to work the leg in circular motion

Working The Hind Legs



Sandy makes circles in both directions to loosen hip, knee and fetlock.



Sandy stretches Grace's hind leg forward and under her body.



Finally, Sandy stretches Grace's leg behind. She circles and taps Grace's hoof to the ground. This helps to "ground" Grace and increase her awareness of the relationship of her leg to her body and to the ground.

Lick of the Cow's Tongue



Sandy begins with her left hand on Grace's belly and "grounds" Grace by resting her right hand on Grace's hip. Sandy glides her hand upward bringing attention from the belly to the back and across the spine. Crossing the midline is an important aspect of this exercise. This action of crossing the midline brings attention from one side of the body to the other and serves to activate both hemispheres of the brain. Notice the position of Grace's ears pointed toward Sandy suggests that she is focused on what Sandy is doing.

Ear and Mouth Work



Sandy glides hand from base of ear to the tip.

Sandy moves Grace's nostril in circle.



Grace is relaxed with eyes closed while Sandy massages her gums.



Sandy smiles as Grace completely relaxes and yawns.

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