CHAPTER FOUR

Brain Function Assessment and Neurotherapy for Sexual Abuse

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Introduction
Childhood makes us who we are. Our childhood is longer than any species on Earth with decades of unparalleled vulnerability. Our vulnerability stems from our large brain, the most expensive organ in nature, which takes years to mature and many more years to work effectively. Our brain is expensive because it comprises a few percent of our body while consuming a disproportionate amount of energy for its size and it takes years of familial and community sacrifice and support before we have any return on our investment, three or four decades before it can produce more energy than it consumes, and all the while it is susceptible to toxins, predation, and environmental hazards which may limit our ability to learn and function.

When the flow of learning is slowed – through abuse, fear, neglect – the consequence is devastating. As Harlow (1963) observed, "Learning to love, like learning to walk or talk, can't be put off too long without crippling effects.” Love and play are the key ingredients of cerebral growth, and loss of love slows us down considerably. Love is not a property of the cosmos but of our own dimensions, the mammalian response to the forces of nature. Our brain is a great experiment in complexity and freedom, developing new circuitry and cells every day of our life, an ongoing attempt to displace the amorality of physics and nature with human and divine principles of communication and preservation. Abuse stands in opposition to this process – and as healers and educators our efforts are to restore the flow of learning.

Abuse scars the brain, which includes loss of neurons, myelin, and capillaries, as well as overactive, underactive, or unpredictable brain function (Shin et al., 1999; Chugani et al., 2001). Childhood sexual abuse damages the limbic system in particular, which is critical to attachment, affiliation, sexual and social behaviors, as well as attention and learning. It impairs our stress response, the hypothalamic–pituitary–adrenal axis, or limbic-HPA axis (De Bellis et al., 1994) and can shift us from cultural categorical-based representations and thought processes to ancient atavistic function based on fears, impulses, and unshared associations (Teicher, Glod, Surrey, & Swett, 1993; Teicher, 2000; Bremner, 2003; Andersen et al, 2008; Ito, Teicher, Glod, & Ackerman, 1998). Abused children often exhibit elevated synchronization of the left hemisphere, indicating a smaller range of available responses to challenges (Cook, Ciorciari, Varker, & Devily, 2009). Excessive left-brain synchronization indicates a loss of functional
differentiation and explains why children with histories of abuse commonly struggle at school, unable to incorporate the range of abilities needed for academic success (Cosden & Cortez-Ison, 1999). It also makes children and adults vulnerable to paranoia and psychotic ideation when overaroused, locked into a limited set of primitive, egocentric beliefs and responses (Young, Hartford, Kinder, & Savell, 2007).

In addition to abnormal mental processing, sexual violation and molestation produces a range of compensatory behaviors. Some who experience sexual victimization act out, others withdraw, and others create dangerous and harmful habits to test the boundaries of safety (Schulenberg & Soundy, 2000). All of these unhealthy responses are associated with abnormal brainwaves (Solomon, Jasper, & Braley, 1937; Fairchild, et al., 2011). The brainwaves of children with impulsivity, aggression and anti-social traits resemble those with seizure disorder, traumatic brain injury, and other pathologies. For instance, children with severe attention problems present abnormal brainwave patterns at three times the rate of healthy children (Capute, Niedermeyer, & Richardson, 1968, Millichap, Millichap, & Stack, 2011), as do their parents and siblings (Kennard, 1949; Hale et al., 2010). Compensatory mechanisms are woven throughout our brain activity and high-functioning adults with a history of sexual abuse show different patterns of connectivity compared to those with worse outcomes (Black, Hudspeth, Townsend, & Bodenhamer-Davis, 2008). EEG abnormalities are a complex mixture of pathology and compensation, which is why an expert is needed to interpret the signal (Nuwer, 1988; Kaiser & Meckley, in press).

The Electroencephalogram
Neurons communicate with each other by means of electromagnetic fields/charged particles. We measure the electromagnetic waves generated by the cortex (neo-, meso- and archicortex) when they pass out of the skull with sensors on the scalp. Each sensor detects neuroelectromagnetism associated with a billion cortical neurons, and this signal is smeared and distorted by the insulating layers (skin, skull, dura, blood, spinal fluid, pia) between the generating brains cells (neurons, glia) and each sensor. Positive and negative potentials cancel each other out and what remains is a fraction of the total activity generated by the cortex in its internal communications, but this fraction provides a wealth of information and allows us to eavesdrop on the workings within in real-time and with relative success (see Figure 1).

Electroencephalography (EEG) has been a basic tool of medicine for nearly a century, with more than 120,000 peer-reviewed publications and five million online publications and documentations. Our brainwave activity contains a myriad of telltale signs, indicators of arousal, attention, pain, perception, as well as stages of sleep and signatures of disease, trauma, and disorder (Berger, 1929; Hughes & John, 1999). Science
has shown for 75 years that abnormalities existed in the EEG of children with behavioral disorders (Solomon, Jasper, & Braley, 1937). However, detection did not lend itself to a direct treatment until the invention of personal computers and powerful algorithms permitted real-time EEG operant conditioning and other forms of neurotherapy (Cooley & Tukey, 1965; Sterman & Friar, 1972). With frequency analysis and inferential statistics, we evaluate functional and structural integrity of cortical areas based on Brodmann histological divisions contributing to the EEG, and with statistical confidence (Sterman & Kaiser, 1999). Shared activity between brain areas is particularly revealing as it provides indicators of functional as well as structural disconnections, which are common to epilepsy, anxiety, autism, learning disabilities, and brain injury (Eluvathingal et al., 2006). In developmental trauma and abuse, for instance, we often find reduced coordination or functional connectivity of the posterior cingulate cortices (PCC) with adjacent areas (Kaiser, 2009) and a goal of neurotherapy in such cases is to reconnect the PCC to posterior cortices as well as the anterior cingulate and to improve relaxing or self-calming abilities of the child or adult (Meckley, Hamlin, & Kaiser, 2011).

Figure 1. Six seconds of EEG data recorded minutes apart from the same young child at 19 electrodes.

EEG Abnormalities in Abuse
The impact of deprivation, abuse, and neglect on a child’s brain development is profound and readily observed in his or her brainwave activity. Three-quarters of
children who suffer incest exhibit excessive slowing, paroxysms, epileptic seizures, or other abnormal brainwaves (Davies, 1979). Children with a history of abuse are three times more likely to exhibit EEG abnormalities than other children (Ito, et al., 1993). Our experience with children of neglect and abuse in a private psychiatric practice confirms these estimates. Of the last 100 children with histories of abuse or neglect referred to our clinic (Center for the Advancement of Human Potential) between the ages 6 and 17, 50% presented with EEG abnormalities that could be visually identified. These abnormalities included paroxysms (10%), which are bursts of activity that have an abrupt start and stop, and are greater than the background activity. Localized slowing, slower frequency activity that is isolated to a region, accounted for 16% of the abnormalities and as noted in other abused populations (Ito, et al., 1993), the majority of these abnormalities resided in the left temporal and frontal regions. Diffuse slowing, where slower frequency activity is found to be distributed throughout the brain, was observed in 20% and a dominant frequency that was considered to be slower than typical for the child’s age was found in 28% (see Figure 2). A slow dominant frequency in this population may be an indication of a maturational lag as a result of early neglect and abuse and possibly why many of these children appear younger than their chronological age in terms of cognitive and behavioral styles. The greatest number of EEG abnormalities in this sample is due to epileptiform activity (38%). Epileptiform activity includes spikes, sharp waves, and spike-wave complexes and is generally regarded as the hallmark feature in epilepsy. However, it has been observed that epileptiform activity also frequently occurs in psychiatric and behavioral disorders. In this population this pattern is viewed as subclinical, indicating an underlying dysregulation without a vulnerability to seizures (Shelley, Trimble, & Boutros, 2008). Although few of these children have experienced seizures, nor are they likely to in the future, it is considered an important feature as these subclinical epileptiform discharges have been associated with transitory cognitive impairment (Binnie et al., 2003). These discharges can result in brief disruptions in cognitive functioning having a negative impact on reaction time, short-term memory, and school performance (Trenite, 1995) and a likely contributing factor to their behavioral and cognitive challenges.
Figure 2. Example of paroxysmal EEG, a sudden burst of slow activity against a normal background mixture of rhythms (left), and local slowing in right posterior sites (right).

Nearly all psychiatric and neurological disorders exhibit abnormal patterns of brainwave activity (Hughes & John, 1999). This is the premise and payoff of neurotherapy. We reduce abnormal patterns of neuroelectrical communication and reward more normal ones using operant conditioning, magnetic or sensory entrainment, and other forms of therapy and educational practices including talk and behavioral techniques. With EEG operant conditioning, individuals learn healthier brain rhythms through reward-based training: whenever a healthy brainwave pattern occurs, we reward the individual with video game-play or positive sounds such as bells or chimes, but when unhealthy brainwave activity occurs, game-play and sounds cease. In this manner bad brain habits are extinguished and good behaviors promoted through basic Skinnerian learning techniques, with the wrinkle being that these behaviors are inside the skull, imperceptible without electrical amplification (Ferster & Skinner, 1957; Sterman, 1996). This transformation of the invisible to the visible allows anyone to watch his or her brain behave at a fundamental level. Typical brain habits targeted by neurotherapy for extinction include frontal lobe slowing, temporal bursts, a slow or absent posterior dominant rhythm (PDR), and excessive fast frequencies. By exercising healthy brainwaves and not rewarding undesirable ones, with time healthy rhythms accumulate until they become prominent in an individual’s brain-behavior repertoire. Neurotherapy exercises the brain towards healthy, normative goals, which is
why it is known as physical therapy for the brain, or computerized meditation, guided mindfulness, and various other labels across our discipline.

**Normative EEG and Neurotherapy for Sexual Abuse**
We evaluated eight childhood sexual abuse cases and found functional disconnection of bilateral anterior cingulate cortices in all cases (BA 24) and disconnection of primary auditory cortex in most individuals (see Figure 3). Of the three rape-murderers we evaluated, all showed disconnection of the left auditory cortex and two showed bilateral cingulate activity indicative of immaturity hyper unity (see Figure 4). Furthermore, all three showed disconnection of BA 9 (2 right, 1 left sided), an area involved in empathy and emotional self-regulation (Farrow et al., 2001; Levesque et al., 2004).
Figure 3. Statistical evaluation of shared EEG activity among brain regions revealed a functional disconnection of the left auditory cortex (labeled “Aud”) and dysfunction of bilateral cingulate and occipital cortices in a childhood sexual-abuse victim (SA). The cingulate is involved in monitoring, adjustment, and updating mechanisms by which we learn the value of actions (Ridderinkhof, van der Wildenberg, Segalowitz, & Carter, 2004; Rushworth and Behrens, 2008).

Figure 4. Statistical evaluation of shared EEG activity among brain regions revealed a functional disconnection of the left auditory cortex (“Aud”) and dysfunction of bilateral cingulate and occipital cortices in a sexual offense perpetrator (SP).
The following two case studies illustrate how EEG analysis and normative comparisons provide a thorough understanding of brain functioning beyond any diagnostic label, how this information can be used to guide neurotherapy, and the impact neurotherapy had on abnormal patterns of neuroelectrical activity and self-regulation.

**Case 1: TC**

TC had a very chaotic start to life. His mother was involved with prostitution and abused substances and his father has never been present in his life. Little is known about his birth history but by 3 months of age he began having seizures and these continued until the age of 7. As an infant and toddler he was noted to just sit and stare. During his childhood he was also the victim of violent sexual abuse by two male family members and at the age of seven his mother was murdered. Around eleven years of age TC began experiencing “blackouts” and by the time he was referred to our clinic at the age of 15 these were becoming quite significant. He typically experienced several blackouts per day that would last anywhere from a few minutes to hours. They were having a significant impact on his life and for the past several years he was only attending school for 4 hours a day. Over the years, he had been assessed by numerous medical professionals and had received numerous forms of outpatient and intensive in-home therapies yet his functioning was not improving. TC had been given several diagnoses including: Post Traumatic Stress Disorder, Generalized Anxiety Disorder, Fetal Alcohol Syndrome, Depression with Psychosis, Attention Deficit/Hyperactivity Disorder, NOS, and Psychotic Disorder, NOS. And unfortunately each diagnosis resulted in a different medication. When we began seeing TC he was taking Adderall, Lexapro, Seroquel, Topomax, Abilify, and Benztopine.

Given TC’s complicated history it was important for us to evaluate his EEG clinically and quantitatively prior to beginning Neurotherapy and as a result several significant features were observed. First, his EEG was found to be dominated by very slow frequency activity and judged by a neurologist to be clinically abnormal due to “…prominent diffuse persistent theta slowing with intermixed delta.” Additionally, his dominant frequency was found to be at 5-7 Hz. This is considerably slower than would be expected for a 15 year-old. In a typically developing, healthy child the dominant frequency should be approaching 10 Hz by this age (Petersén & Eeg-Olofsson, 1971). When compared to the normative database a pattern of elevated slow frequency activity was also observed. Due to the lower voltage nature of the record, this was found to be more accurately identified in relative measures where a significant increase in 2-8 Hz and decreased activity in the 9-12 Hz range with eyes closed, as well as the beta frequencies with eyes open, was noted. It should be mentioned that this pattern of elevated slow frequency activity was likely influenced by medication effect as several of the medications he was taking at the time are known to result in slowing of the EEG. Numerous disruptions in connectivity were
also identified. One pattern of particular interest was asymmetries in the theta frequencies between the right posterior cingulate and other posterior Brodmann regions, indicating a functional disconnect between these regions. Other imaging techniques have identified abnormalities in the right posterior cingulate in individuals who have experienced psychological trauma (Lanius et al., 2004; Bluhm et al., 2011), and given TC’s history this was viewed as an important feature. Additionally, a mild hypocoherence in the alpha frequencies was found between Brodmann regions in the left and right hemispheres suggesting a decrease in the strength and number of connections between the associated regions.

Based on these findings, his history of seizures, and his current episodes of blacking out neurotherapy began by rewarding SMR activity (12-15 Hz) over the sensory-motor strip (C4 and C3-C4) while inhibiting the slow frequency activity (2-7 Hz). Once some degree of stabilization had occurred and his black outs began to decrease other protocols were introduced including rewarding 9-11 Hz activity at Pz and 4 channel z-score training. TC completed a total of 106 training sessions in the course of 16 months. He continued to participate in psychotherapy and as his blacks out began to decrease his medications were slowly reduced. At the time of the second evaluation he was taking Seroquel, Lamictal, and Abilify with the goal of gradually reducing these as well.

A follow up quantitative EEG evaluation revealed significant changes in neuroelectrical activity and communication (see Figures 3-6). The slower frequency activity that once dominated the background of his EEG was found to have decreased. This was visually identifiable in the EEG as well as through quantitative analysis. An increase in the speed of his dominant frequency was also noted and now found to be in the 7-9 Hz range and more rhythmic sinusoidal activity was visible in the EEG tracing. Although there continues to be greater slow frequency activity than typical for someone his age and the dominant frequency is still slow, these changes indicate significant maturation of the central nervous system. Patterns of connectivity were also found to be changing with improved functional connectivity with the right posterior cingulate and normalization of the hypocoherence of the alpha frequencies. These changes in connectivity are found to be of particular interest as evidence suggests childhood trauma may result in enduring changes in neuronal connectivity impacting victims into adulthood (Cook et. al, 2009). Cognitive testing also demonstrated an improvement in TC’s cognitive functioning with a 17 point increase in his full scale IQ as measured by the WISC-IV. Despite this increase his IQ still remains in the extremely low range at 65: however, as his blackouts substantially decreased he began attending school for a full day during the past academic year. It is hoped that as he is better able to take part in the academic environment his cognitive functioning will continue to improve.
As a result of adding neurotherapy to TC’s treatment program he made fairly substantial changes in a somewhat short period of time, but nevertheless he still has a long road ahead of him to overcome the impact created by early neglect and abuse. The question that still lingers is what if Neurotherapy was more widely accepted and available and TC (and other children like him) had access to this modality at a much younger age?

Figure 5. Representative samples of EEG voltages recorded from 19 scalp electrodes for 10 seconds using conventional electrode positions. EEG signals are organized front to back, left to right, so that the foremost left anterior site (FP1) is on top and the most posterior site on the right side is the last channel (O2). Slow rhythms dominate this pre-training recording (top chart) but were largely extinguished with training (bottom chart).
Figure 6. Nine frequencies of a single Hz interval (e.g., 5-6 Hz) are shown for 19 electrode sites ranging from 5 to 13 Hz. The amount of spectral magnitude is shown with color, with oranges and reds indicating high values (12 microvolts) and blue low values (0 microvolts). Magnitudes are displayed from the perspective of looking down on a head, with the nose in front and the ears to either side – a triangle and half circles, respectively. Prior to neurotherapy, TC exhibits a posterior dominant rhythm (PDR) from 5-8 Hz, which is evidence of cortical immaturity. After training TC exhibits a faster PDF of 7-9 Hz, which is closer to the typical adult PDR.
Figure 7. Spectral entropy (relative activity) is shown for 39 integer frequencies (1-2 Hz, 2-3 Hz, to 39-40 Hz) for 19 electrode sites as in Figure X. Prior to neurotherapy, TC exhibits excessive low frequency at all or most electrode sites with diminished middle frequencies. A training TC exhibits significantly less slow activity, especially 2-4 Hz, and more normalization middle frequencies with room for further normalization.
Figure 8. Shared activity in alpha coherence is shown statistically for 19 brain regions using an inverse solution known as the Brodmann montage. Each circle represents an area’s alpha coherence value to all other areas presented statistically in relation to healthy norms. Prior to neurotherapy, TC exhibits hypo coherence of medial regions in the alpha band, as evidenced by blue shading in the center two columns of head. Deep blue shading indicates 2 or more standard deviations below the mean on this measure of shared phase information between brain areas. After training TC shows normalization of
coherence for all regions but right occipital cortex.

Case 2: AH
AH also experienced a very chaotic start to life. Her birth mother was only a teenager and in foster care when she became pregnant. It is suspected she abused drugs and alcohol while pregnant, but the extent of her use was unknown. She was removed from her mother’s care at an early age due to severe neglect, and placed into foster care. Unfortunately, these settings were less than ideal as she experienced physical and sexual abuse until the age of 9 when she was placed in a children’s group home. AH was adopted and had been in a much more stable environment for about a year and a half when she was referred to our clinic at the age of 11. Her adoptive mother reported noting considerable improvement in her behavior in the time AH had been in her care, yet she still struggled with regulating her emotions. She could become physically aggressive at times, was impulsive in her actions, and had great difficulty relating to her peers and making friends. The primary complaint, and what was considered to underlie these behaviors, was significant and pervasive anxiety with extreme hyper vigilance. AH reportedly would bolt upright in bed if her bedroom door was opened to check on her after she had fallen asleep and enuresis was still an almost nightly occurrence.

The initial quantitative analysis of her EEG revealed several important features. Dysregulation was noted in the parietal regions with elevated activity in the 9-13 Hz range as well as in the beta and gamma frequencies. The parietal regions are important for sensory integration, bodily awareness and aspects of attention. Significant asymmetries were also noted with the right auditory cortex in the theta frequencies. We have hypothesized that this pattern may have developed in response to her early abusive environment. The right hemisphere is much more adapt at processing the emotional content to language (tone, infection, sarcasm) and very often this emotional content conveys more meaning than the actual words themselves. Differences in functional connectivity with this region may have been an adaptive mechanism as paying attention to these subtleties of communication may have allowed her to avoid abusive situations. Based on these findings, and the primary complaint of anxiety and hypervigilance, we began Neurotherapy by training in the right posterior region using a bipolar placement (T4-P4 rewarding 5-7 Hz and inhibiting 9-11 Hz and 22-36 Hz). Our clinical experience (also known as trial and error learning) has been that training in the right posterior quadrant helps to calm and stabilize the individual. Once her anxiety and hypervigilance began to decrease, we incorporated other training protocols including SMR enhancement along the motor strip (C3-C4) and four-channel z-score training. All combined AH completed 56 training sessions over 14 months. A follow up quantitative EEG evaluation revealed significant improvement in regulation of the posterior regions with more normalized patterns of activation. However, relative comparisons continued to show an
imbalance in the distribution of activity with excessive 9-11 Hz particularly in the left frontotemporal regions and generalized decreases in 5-7 Hz activity. Although her anxiety level and hyper vigilance had significantly decreased during this time she still struggled with mood regulation, anxiety, and memory issues. Therefore, we felt continued training to address the regulation in the temporal regions would be beneficial as excess 9-11 Hz activity in the temporal region could be contributing to these issues. Interestingly, the theta asymmetries with the auditory cortex were found to be more statistically significant than prior to training. This illustrates an important issue in quantitative analysis. Often in the course of Neurotherapy, particularly in measures of connectivity, greater deviations from the norm will occur. This may be the result of reorganization that will normalize with more training, or the changes could be a compensatory mechanism. Statistical deviations must always be viewed in light of an individual’s symptoms and complaints. In this particular case, given the significant behavioral changes that were being reported, we did not view this as a negative finding but felt it may be related to the other dysregulation noted in the temporal regions and may improve with continued training. AH completed another 18 training sessions using a bipolar (T3-T4) placement rewarding 5-7 Hz activity while inhibiting 9-11 Hz and 22-36 Hz. This training showed very specific frequency effects with a generalized normalization of the 5-7 Hz activity as well as decreased asymmetries of the theta frequencies with the auditory cortex (see Figure 7-8). More importantly her anxiety was found to decrease even further and her mood improved. Aspects of her memory were also found to be improving and this was very beneficial for her academically. She was able to pass her end of grade tests without having to retake any portions, a significant accomplishment for her. AH also began therapy to specifically address issues related to the sexual abuse, something she had not been able to do previously due to her anxiety level.
Figure 9. Relative spectral magnitude (spectral entropy) is shown in 2-Hz bands from 1-41 Hz for all 19 sites. Prior to neurotherapy, AH exhibits deficient theta (5-7 Hz) and excessive gamma (37-39 Hz) activity at nearly all sites. After training, her rhythms have largely normalized.
Figure 10. Prior to neurotherapy, AH exhibits a functional disconnection of the right auditory cortex, which is partly normalized with training. Theta unity is a measure of similar or dissimilar desynchronization between brain areas across time.
Many questions remain as how best to apply neurotherapy in this very difficult population. These two cases highlight how neurotherapy can address brain dysregulation associated with abuse. Although a powerful and promising modality, by itself neurotherapy cannot completely undo the impact caused by neglect and abuse. Sexual abuse is often wrapped in a milieu of prenatal drug exposure, neglect, and physical abuse which often delays or hinders brain development. It does not magically undo the past nor is it a quick fix. Decreased arousal and improved behavior do not happen overnight. Neurotherapy is more akin to physical exercise than it is to treatment, as exercise strengthens muscles by repeated practice so we routinize healthier brain patterns with repeated practice. A strength of this technique is how we transcend words and consciousness and provide a way to interact directly with the brain through its communication and metabolic patterns, allowing us to circumvent defenses that consciousness-based therapies constantly face in this population.

Our experience has been that by improving brain organization and self-regulation along with decreasing arousal these individuals are more capable in participating in and benefiting from traditional forms of therapy. As illustrated with TC, therapy was challenging as broaching emotional topics often caused him to black out. Once he gained greater central nervous system stability he was less likely to fade and better able to handle emotional topics. The same is true for AH who prior to neurotherapy could not address the memories of sexual abuse due to her hyper vigilance and arousal. She needed to feel safe before she could explore and integrate her past.

Metaphorically, a normative EEG evaluates the village we call our brain and determines where the village is missing elders, or overpopulated by them and unable to change, where the parents and children are working together and where they are not, where the individual is alone and where they are surrounded by the past. Using real-time EEG operant conditioning as well as other forms of neuromodulation, counseling, and other therapies, we attempt to restore or re-establish the village, improve healthy behaviors physiologically and in so doing provide the framework for healthy thoughts and behavioral habits and restore the flow of learning.

Further descriptions of neurotherapy and normative EEG are provided at: http://sababrainanalysis.org/ScientificPrinciples.htm

References

Neuroscience, 20, 292-301.


De Bellis, M.D., Chrousos, G.P., Dorn, L.D., Burke, L., Helmers, K., Kling, M.A.,
dysregulation in sexually abused girls. *Journal of Clinical Endocrinology
Metabolism, 78*, 249-255.

Eluvathingal TJ, Chugani HT, Behen ME, Juhász C, Musik O, Maqbool M, Chugani DC,
socioemotional deprivation: a diffusion tensor imaging study. *Pediatrics, 117*,
2093-2100.

abnormalities in early-onset and adolescent-onset conduct disorder. *American

empathy and forgiveness. *Neuroreport, 12*, 2433-2438.

Prentice-Hall.

Hale, T.S., Smalley, S.L., Dang, J., Hanada, G., Macion, J., McCracken, J.T., McGough,
J.J., & Loo, S.K. (2010). ADHD familial loading and abnormal EEG alpha


electroencephalography in psychiatry. *Journal of Neuropsychiatry and Clinical
Neuroscience, 11*, 190-208.

Increased prevalence of electrophysiological abnormalities in children with
psychological, physical, and sexual abuse. *Neuropsychiatry and Clinical
Neuroscience, 5*, 401-408.

cortical development in abused children: a quantitative EEG study. *Journal of


