



Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience

Abnormal QEEG Patterns Associated with Dissociation and Violence

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Published online: 20 Oct 2008.

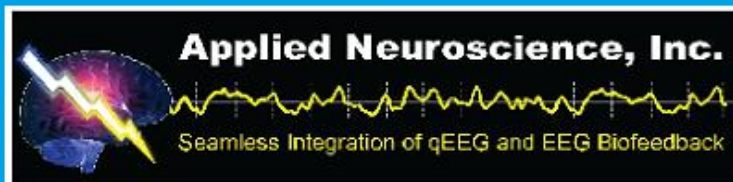
To cite this article: James R. Evans Ph.D. & Suzanne Claycomb B.A. (1999) ABNORMAL QEEG PATTERNS ASSOCIATED WITH DISSOCIATION AND VIOLENCE, *Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience*, 3:2, 21-27, DOI: [10.1300/J184v03n02_03](https://doi.org/10.1300/J184v03n02_03)

To link to this article: http://dx.doi.org/10.1300/J184v03n02_03

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ABNORMAL QEEG PATTERNS ASSOCIATED WITH DISSOCIATION AND VIOLENCE

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A group of ten men with histories of violent behaviors and who reported dissociative type experiences were found to have specific QEEG abnormalities. In six cases there was abnormally excessive relative power at frontal (and sometimes anterior temporal) sites in the alpha frequency band. These men either strongly denied awareness that they had engaged in specific violent behaviors, seemed only vaguely aware, or were aware, but perceived having been controlled by an external force, e.g., satan. This is discussed in terms of earlier reports of a correlation of hypnotizability (and, by inference, self-hypnotizability and dissociation) with high amplitude alpha. In four cases paroxysmal delta waves were observed in the raw EEG primarily at site F8, but occasionally also involving other frontal and right temporal sites. In all four cases the men had histories of engaging occasionally in behaviors which had no cause apparent to them or others, with some of these behaviors involving violence, at times accompanied by delusions. The possibility of this raw EEG abnormality being a marker for at least one type of intermittent explosive disorder is discussed. These findings, if replicated, have relevance to forensic situations and to the application of neurofeedback procedures in the prevention and treatment of some types of violence.

This research was funded in part by a grant from the University of South Carolina Venture Fund.

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Violent behaviors have been related to brain damage/dysfunction in several research reports and literature reviews [see, for example, Lewis, Pincus, Feldman, Jackson & Bard (1986), Tancredi & Volkow (1988), and Raine (1997)]. Dysfunction of the frontal or prefrontal cortex most often is indicated, suggesting that problems with executive functions such as self-monitoring, advance planning, and control of impulses and emotional responsivity predispose toward violent behaviors.

In quantitative EEG (QEEG) assessments of over fifty men convicted of murder or other violent crimes (or known to show periodic violent behaviors) the first author also has found a predominance of frontal abnormalities. Findings with a subset of twenty of these who

were on death rows were reported earlier. (Evans & Park, 1997) The present paper describes two specific frontal/anterior temporal EEG patterns which were noted in a subset of ten cases and which appear to involve dynamics which could put one at-risk for violent acts. These patterns are: (1) excessive alpha band relative power at frontal and/or anterior temporal sites during eyes closed, resting conditions; and (2) paroxysmal large amplitude delta waves observed in the raw EEG especially at site F8, but in some cases involving other frontal and/or right anterior temporal sites, during eyes closed, resting conditions. These patterns and some behavioral correlates will be described below, along with speculation on how they may mediate violent behaviors.

Method Subjects

Subjects were ten men from a larger group of over fifty convicted of violent crimes (and/or having histories of violence), and who had QEEG evaluations completed by the first author. They were selected for the present study because each had reported a history of dissociative type experience related to acts of violence.

Procedure

For all QEEG assessments Lexicor Neurosearch 24 equipment was used in conjunction with Lexicor V151 software and the appropriate size electrode cap from Electro-Cap International Incorporated. Three to five minutes of EEG activity was sampled during an eyes closed, resting condition from 19 scalp electrode sites in the standard International 10-20 montage, with reference to ear lobes, and ground just forward of site FZ. Sampling rate was 128 Hz with 32K gain, and high pass filter off. Subjects were seated in an upright position and asked to relax and to try to keep eyes closed and still. After EEG sampling was complete, wave forms were inspected off-line and artifacts eliminated by a certified QEEG technician.

All but one record contained at least the minimal 60 seconds of artifact-free EEG activity recommended by Thatcher (personal communication, January, 1999) for use with his reference database. The one exception contained 46 seconds of artifacted EEG. Data analysis was completed using Neurorep software (Hudspeth, 1994) which incorporates the Thatcher Lifespan EEG Reference Database. (Thatcher, Walker & Guidice, 1987) Measures of coherence, phase, and amplitude asymmetry were computed in four frequency bands among all combinations of eight left and eight right intrahemispheric sites and between

homologous interhemispheric sites. Relative power in each of the same frequency bands at each of 16 electrode sites also was calculated. Frequency bands involved in data analysis were: Delta (.5-3.5 Hz), Theta (3.5-7.0 Hz.), Alpha (7.0-13.0 Hz), and Beta (13-22 Hz.). A total of 832 raw scores were calculated for each subject, transformed to Z scores and printed along with indications of which scores differed significantly from the reference database norms for the subject's age, gender and handedness. Specifically, a difference was considered significant if the probability of it being a chance finding was equal to or less than two and one half times in 100, i.e., if the statistical probability of chance was $<.025$ (two tailed test of significance).

Results

In the QEEG records of six subjects there was significantly excessive relative power in the alpha frequency band at four or more frontal sites (and often at anterior temporal sites) (see Table 1). This group included four African-American and two Caucasian males, with a mean age of 25.7 (standard deviation 3.4), and a mean IQ of 89.2 (standard deviation 15.5). Some of these men appeared to have no memory of, and adamantly denied involvement in, the crimes of murder of which they had been convicted (despite strong evidence of their guilt). Others seemed quite confused about whether or not they were involved, or admitted to involvement, but claimed strongly to believe that their actions were under the control of some external force such as Satan.

The raw EEG data of four subjects was characterized by paroxysmal large amplitude delta waves at scalp site F8, and in some subjects also at other frontal and anterior temporal sites, i.e., F7, Fp1, Fp2, F4, Fz, T4. This group included two African-American and two Caucasian males, of mean age 27.0 (standard deviation 8.8), and mean IQ 78.8

(standard deviation 14.2). These men all had histories of episodic behavioral dyscontrol, at times involving violence, which seemed to them and others to have no rational cause.

Discussion

While it is, of course, possible that the six subjects showing excessive frontal alpha power were fully aware of their parts in the crimes, but simply unwilling to admit responsibility, the association of these claims with high alpha power suggests other possibilities.

Since the 1960's there have been frequent reports that highly hypnotizable persons show higher EEG alpha power during eyes closed, resting conditions than low hypnotizable persons. (e.g., London, Hart, & Liebovitz, 1968) This finding was not always replicated in subsequent studies, and the alpha-hypnotizability correlation research has been strongly criticized by some. (Perlini & Spanos, 1991) In a recent study which controlled for many of the criticisms of earlier research, Graffin, Ray, & Lundy (1995) found significantly greater alpha power at temporal sites (T3 and T4) for highly hypnotizable persons, but not at frontal sites. They did, however, find this relationship at frontal sites for power in the theta band (3.91-8 Hz.), which overlapped the alpha band (7.00 -13.00) used in the present study. Such inconsistency in this research is not unexpected in view of the variety of definitions of the alpha band, electrode sites involved, measures used, and subject populations. To the authors' knowledge, no study of EEG correlates of hypnotizability has used a measure of relative power or a reference database.

Assuming a positive relationship does exist between alpha power and hypnotizability, one also might reasonably expect increased susceptibility to self-hypnosis in persons such as the six subjects discussed here. Relatedly, a

theory of dissociative phenomena is that these represent a form of self-hypnosis (Comer, 1998), i.e., persons experiencing dissociative phenomena may have put themselves in a hypnotic trance. Dissociation is defined in the Diagnostic and Statistical Manual of the American Psychiatric Association IV (DSM-IV) (American Psychiatric Association, 1994) as disruption in the usually integrated functions of consciousness, memory, identity or perception of the environment. Psychogenic amnesia is one of the dissociative disorders listed in DSM-IV, and phenomena such as trance states, out of body experiences, a sense of being possessed or controlled by external forces and experiencing movements as being beyond one's control have been included in this diagnosis. (Bernstein & Putnam, 1986) A common psychodynamic formulation of dissociative phenomena is that they involve one's unconsciously repressing anxiety-provoking thoughts, memories or impulses to prevent conscious awareness of them. Such repression may have been learned in childhood as a defense against psychological, physical or sexual abuse, and used similarly in later life at times of major stress or conflict.

Thus it could be reasoned that persons with high relative power in the EEG alpha frequency band are highly susceptible to hypnosis, and, perhaps especially if they were victims of childhood abuse, have learned to use self-hypnosis/dissociation as a defense. When confronted with stress, such as would be common for many persons immediately before, during, and immediately after commission of a violent act, a spontaneous trance state may occur accompanied by dissociative phenomena, such as a sense of possession, and sometimes by amnesia for the event. Another form of stress with potential for triggering dissociation may be strong approach-avoidance conflict, as when a strong desire to engage in violence toward another is countered by strong feelings of guilt or fear. In such cases the conflict may

be “solved” by dissociation in susceptible persons. Such dissociative states apparently also can be precipitated, or facilitated, by certain medications and substances (Good, 1989), and may more readily trigger them in persons already at-risk.

The apparent dissociative amnesia and sense of possession characterizing the six subjects with excessive relative alpha power at frontal sites was not reported by the four subjects with paroxysmal frontal delta activity. Rather, they reported a dissociative-like sense of confusion over why they inexplicably engaged periodically in violent behaviors. Each of these four subjects will be discussed in the following paragraphs, followed by speculation on the relationship of these EEG findings to these behaviors.

The first case involved a death row inmate whose attorney had requested a post conviction relief hearing. During the evaluation this man confided that he did not plan to appeal, and was proceeding with the evaluation only to try to determine why he had unpredictable episodes of violent behaviors (during two of which he killed the victims). This 36 year old Caucasian male of average intelligence claimed to be puzzled by these episodes which he felt had no basis in environmental events. His QEEG results indicated rather widespread abnormality, with a concentration at frontal sites, but very large amplitude delta waves also were noted in the raw EEG at site F8 and to a somewhat lesser degree at site F7 during much of a five minute sample.

The second case involved a thirty three year old African-American male of “borderline” level intelligence convicted of killing two persons for no apparent reason. When questioned about his motives he replied “things happen.” Examination of reports of other professionals involved in the case revealed that he used this term (“things

happen”) quite regularly—as if he had no sense of causality. His QEEG record also was characterized by a predominance of frontal (and right side) abnormalities, but of special relevance here is that paroxysmal delta frequency waves were noted in his raw EEG at site F8, often spreading to sites F4 and T4.

The third case was a nineteen year old African American male of “borderline” level intelligence convicted of murdering a man who caught him in the act of burglarizing his car. He appeared perplexed that he responded with such violence. His raw EEG was characterized by paroxysmal delta activity at site F8, and almost equally at sites Fp1 and Fp2.

The fourth case was a twenty year old African-American male of borderline level intelligence who had not been convicted of a violent crime, but had a history of episodes of dyscontrol (e.g., suddenly chasing his mother with a butcher knife), and sudden peculiar delusions (e.g., believing he “may have” had sex with his dog). Both he and his Mother seemed perplexed over these episodes which had no apparent cause. Paroxysmal delta activity also was noted in his raw EEG tracings primarily at site F8, but at times equally at sites T4, F4 and Fz.

Associations of episodic violence with abnormal frontal and temporal activity have been reported by others. Gedye (1989) reported on twenty cases of mentally handicapped persons with non-convulsive ictal signs of frontal lobe seizures, and proposed that involuntary aggression occurring with such ictal phenomena reflects frontal lobe dysfunction. Fornazzari, Farcnik, Smith, Heasman & Ichise (1992) presented case studies of three persons showing abnormal intermittent EEG discharges arising from frontal areas. These persons experienced sudden intrusive thoughts or visions, and one of them had been charged with the unprovoked

stabbing of a stranger. Similar spontaneous, uncontrollable behaviors have been linked to psychomotor seizures and temporal lobe epilepsy which can result from traumatic brain injury. (Diaz, 1995)

In a study of 23 patients diagnosed with intermittent explosive disorder or episodic dyscontrol, Drake, Hietter & Pakalnis (1992) found seven to have diffuse or focal EEG slowing. Pontius (1993) suggests that brief switching of control from frontal lobe systems to a 'limbic action program' (perhaps by stimuli that revive past "hurts") can result in psychosis and violence which lacks motive and intent. This is referred to as Limbic Psychotic Trigger Reaction (or LPTR).

Based on the above it seems reasonable that the intermittent delta waves seen in the raw EEG of these four men reflect right frontal/anterior temporal dysfunction (perhaps of a transient nature) which may be the direct cause of their episodic dyscontrol.

Summary and Conclusions

Most research on neurological correlates of violent behavior has indicated a predominance of frontal and frontal/anterior temporal abnormalities. This paper reported on two specific abnormalities of these types noted in a few clients which seem to relate to specific forms of violence. These forms include violent behavior for which the perpetrator is totally or partially amnesic or has a sense of having been controlled by external forces, as well as that which appears to him and others to "just happen", i.e., to be unmotivated and irrational.

While the dynamics discussed above may be direct causes of some violent behaviors, it is to be emphasized that these specific abnormalities were accompanied by other QEEG abnormalities, reflecting a complex neurophysiology unique to the individual. All

or nearly all cases of violent behaviors surely involve interactions not only with other biological dysfunctions (e.g., limited intelligence, alcohol and other substance use), but also with non-biological factors such as high levels of life stressors and repeated exposure to violence. (Loeber & Hay , 1997) As reported by Raine, Brennen, Mednick & Mednick (1996) in a study of risk factors for criminal behaviors, "crime rates were highest among subjects with both biological and psychosocial risk factors." All persons with high frontal alpha power do not dissociate under stress and engage in violent behaviors. Furthermore, episodes of dyscontrol associated with abnormal frontal/temporal EEG events do not always involve violence.

There is obvious relevance of the EEG abnormalities reported here to forensic situations. If a perpetrator of a violent crime truly entered a trance-like state prior to (or perhaps during) commission of a crime due to a biological tendency to enter such states and was either amnesic for the event or felt externally controlled, this might be seen as a mitigating factor in determining guilt and penalty. Of course, it likely would prove impossible to determine that the dissociated state occurred prior to or during the crime (rather than after), thus leaving a judge or jury with nothing more than a reasonable doubt that the crime was voluntary. Similarly, presence of paroxysmal slow wave EEG activity at frontal/temporal sites (and probably other transient frontal/temporal "events") might be considered evidence for neurologically based episodes of behavior over which the individual has little or no voluntary control.

There is much room for abuse in use of such arguments in cases of violent crimes. Therefore, it is of extreme importance that very thorough neurological and multidisciplinary evaluations be made, including searching for independent evidence of prior dissociation

under stress or prior episodes of behavioral dyscontrol. Certainly the findings of this study need to be replicated and researched further before being used in a forensic setting as anything more than suggestive of possible factors which would require supportive evidence from other independent sources.

These findings have relevance for treatment. It is possible that these EEG patterns reflect abnormal biological processes which would respond favorably to medication, with resultant positive behavioral change. Furthermore, both appear to be "naturals" for treatment through neurofeedback. An obvious suggestion for the first type abnormality would be SMR or beta training at relevant frontal/temporal sites. Inhibiting of delta activity, or perhaps even the generalized regulatory effects of neurofeedback being demonstrated by many practitioners (Othmer, Othmer & Kaiser, 1999), should have a positive effect on the second pattern of paroxysmal frontal/temporal activity.

With the growing incidence of violent behaviors in our society there is an urgency for research on prevention of violence and recidivism. Perhaps screening for and treatment of these two easily recognized EEG abnormalities would be promising places to focus research attention.

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