Break Down the Electroencephalography

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November 30, 2009

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The world of medicine is constantly expanding into new territories. Cures for diseases are constantly being researched and artificial limbs are being placed into people without rejection. As the saying goes "Rome wasn't built in a day." I think it *may* have taken scientists and doctors more than a day to discover cures for diseases and figure out how to put an artificial hip into a complex body without causing more problems. Scientists can all relate to at least one concept: Try, try, and try again. Many tests must be run to even begin to solve a problem and a variety of tests as well. The test discussed in this paper is the EEG, also known as an electroencephalography. The reasons behind a person needing to have an electroencephalography will be evaluated as well as what happens afterwards.

A seizure is a symptom of epilepsy, a neurological condition. (Fisher) A seizure is typically defined as an abnormal movement due to unusual electric activity in the brain. (WebMD.com) Neurons transmit electrical impulses that communicate with areas of your brain. When these bursts of electrical impulses in the brain misfire and spread throughout the body to the muscles a seizure occurs. (Fisher) (WebMD.com) Although seizures are a disorder of the brain there is no evidence of them that is known to cause brain damage. (Fisher) They are painless to the person having a seizure and usually last between 30 seconds to two minutes. (Lindberg) Seizures are different in each individual that experiences them. Most people living with epilepsy identify triggers that cause their seizures. Some things that could provoke a seizure are missing doses of seizure medication, sleep deprivation, stress, alcohol or drug abuse, menstrual cycle, nutritional deficiencies, or taking over the counter medicines such as ones containing diphenhydramine. (Fisher)

There are two major types of seizures: general or partial. During a general seizure, also known as a grand mal seizure, a person may cry out, stiffen, and make rhythmic movements with their arms and legs. Their eyes will typically be open and they may appear to have stopped breathing but will gradually return to consciousness within a few moments. All parts of the brain are affected during a general seizure. When an individual experiences a partial, or focal, seizure only part of their body is affected because only part of the brain is affected. For example, if the part of the brain that controls the foot is involved, usually only the foot has rhythmic movements. Other symptoms may include lip smacking, picking at clothes, or appearing dazed or confused. (WebMD.com)

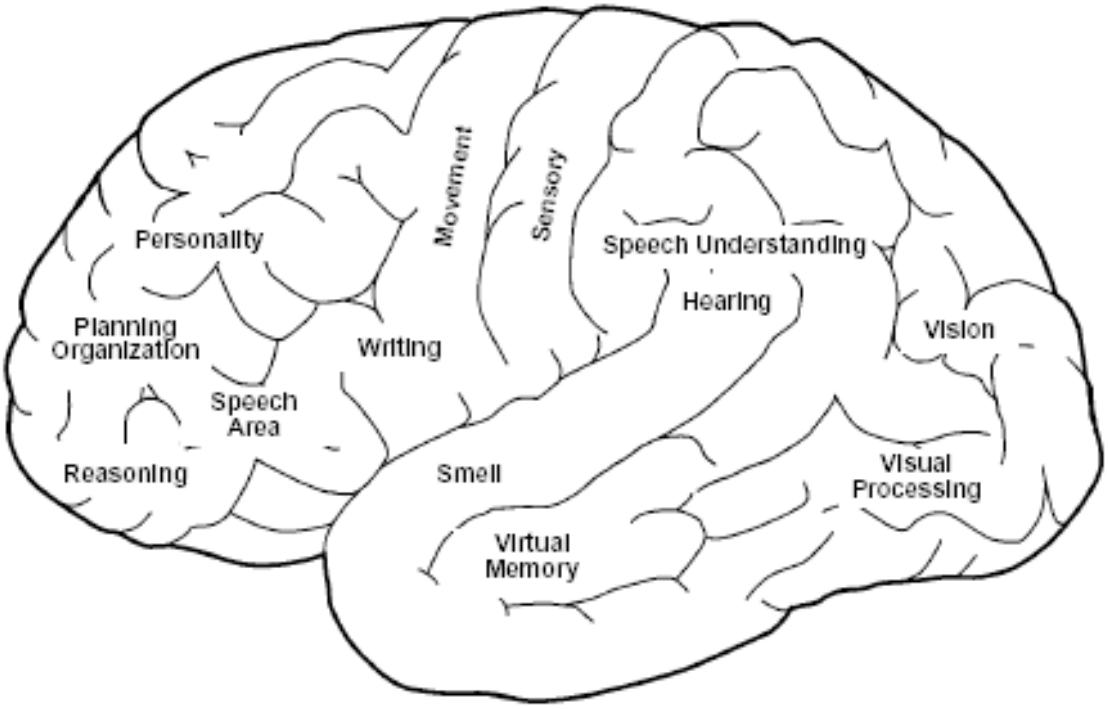

Figure 1. Map of the brain and what it controls

Diagnosing seizures and epilepsy requires information from lots of tests. Medical history details, blood tests, EEG tests, CT and MRI scans are some tests that can explain the seizure in more detail. (Fisher)

An electroencephalography (e-LEK-tro-en-SEF-uh-LOG-rah-fee), more commonly known as an EEG, is the most important and useful test in diagnosing epilepsy. It painlessly records electrical activity in the brain. (Fisher) (WebMD.com) The main focus of the EEG is to answer three questions: Do you have epilepsy? Where is the epileptogenic zone? Will therapy help you? (Noachtar 22)

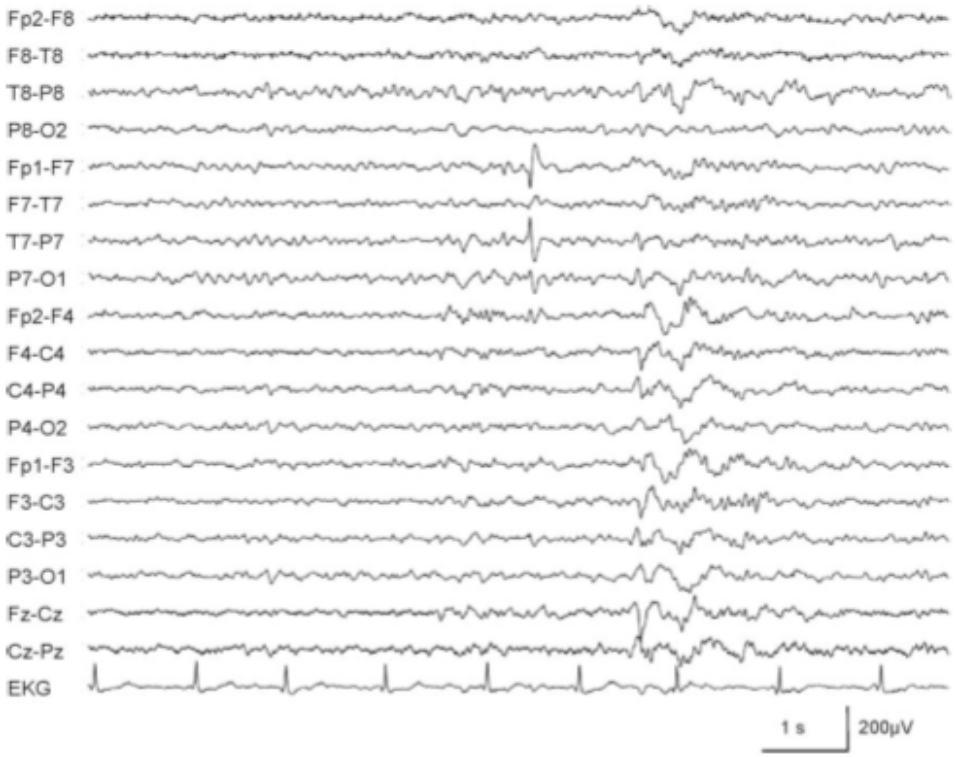

Figure 2. The EEG of a 32-year-old patient with epilepsy

The first discovery of electrical current in the brain was by Richard Canton in 1875. The Liverpool surgeon exposed brains of rabbits and monkeys to place electrodes

and record the activity. His results were published in the British Medical Journal. ("Electroencephalography") But it was Hans Berger, a German neurologist that used ordinary radio equipment to amplify the brains electrical activity so it could be recorded. "The Father of Electroencephalography" studied Canton's work and in 1924 published the first EEG known to man. (Zifkin 30-31) Electrodes and EEG machines altogether have advanced over the years. Caps with electrodes pre placed are now being used and computers are replacing simple pens as recording devices.

Figure 3. An old EEG compared to a newer version

The process of having an EEG test is very thorough and precise. The person is typically asked to be sleep deprived prior to the test because it increases the chance epileptic waves appearing on the EEG. (Electroencephalography) 24 electrodes are placed with a paste (or more modernly with a cap, see figure 6) on the scalp in exact positions by a technician. Then, the EEG records electrical currents from the brain to the machine. Swallowing, sleeping, and blinking are noted throughout the test. After ten

minutes a few tests are performed in an attempt to affect brain activity such as opening and closing the eyes, breathing deep, and flashing a light into closed eyes.

After the 20 to 45 minute test is completed, the doctor interprets the recordings. (Fisher) Finding exactly where the epileptiform discharges and identifying IEDs are a couple crucial abilities of the EEG test. Pinpointing the location of the epileptogenic zone is important for patients whom are considering epileptic surgery. (Noachtar 25) The epileptogenic zone is also the region in which partial seizures start from. This detailed information can not only aid a surgeon but also it allows the doctor to provide a much more specific treatment option directly related to where the patient's seizures begin. To decipher whether or not a person should be diagnosed with epilepsy or not mainly depends on the interictal epileptiform discharges. The IEDs can differentiate between a person with epileptic attacks and non-epileptic attacks. They consist of spikes, sharp waves, benign epileptiform discharges of childhood, spike-wave complexes, slow spike-wave complexes, 3-Hz spike-wave complexes, polyspikes, hypsarrhythmia, seizure pattern, and status pattern. (Noachtar 22) The IEDs are so precise that only 2-3% of people with healthy IEDs develop epilepsy in the future.

EEG pattern	Epileptic syndrome/etiology
Anterior temporal spikes	Mesial temporal lobe epilepsy
Generalized 3-Hz spike–wave complexes	Absence epilepsy
>4-Hz spike–wave complexes, generalized polyspikes	Juvenile myoclonic epilepsy
Generalized slow spike–wave complexes	Lennox–Gastaut syndrome
Regional (extratemporal) polyspikes	Focal cortical dysplasia
Hypsarrhythmia	West syndrome

Figure 4. Typical IEDs in patients with epileptic symptoms

In 1997, when the 'old' EEG equipment (shown in figure 3 above and in figure 5 below) was being used I had an EEG. I had to stay up all night to be properly sleep deprived and went into a dark bedroom in the doctor's office for my test. Jelly-like electrodes were still being used twelve years ago and they were put all over my head and in my hair. My dad remembers the technician flashing strobe lights and me falling asleep. I was also asked a few questions, for example if I was tired or not.

Figure 5. A lovely Polaroid of a sleep deprived child (Lauren Tessaro) after her EEG test in first grade

Figure 6. A modern example of boy having an EEG

Although it is not a major type of seizures, absence seizures are very common in children. Consciousness is lost for a few seconds and the person usually stares blankly and stops what they are doing. These types of seizures can actually happen multiple times a day without the person even realizing they are having a seizure. It would normally feel like daydreaming. (WebMD.com) I was tested for epilepsy when I was in first grade because I had two seizures. My first seizure was when I was only 15 months and my second in first grade. I don't remember the experience because it was too long ago but my dad and classmates can account for my second seizure. I was coloring a house and suddenly my eyes dazed but stayed open and I dropped my crayon. According

to these recollections and my research, I feel I may have had an absence seizure. Apparently, my friend Hailey Guild slapped me in an attempt to wake me up. She still to this day will always remember hitting me and I'm glad I don't. I vaguely remembered being in art class and the next thing I knew I was in the hospital. It actually may not have even been necessary but the school nurse called 9-1-1 and I was taken to the hospital where I stayed for a few days to have tests run. It was my second seizure so my doctor decided I should have an EEG just to be sure. The EEG turned out normal. My seizures ended up being non-epileptic and were induced by a high fever. Sometimes seizures can reoccur at regular intervals and lead to epilepsy. If I had a seizure again when I was around the age of 13 that may have been a problem but I haven't had one since. (Tessaro)

Following an EEG and multiple other tests the tests may be repeated or a person may be diagnosed with epilepsy or not. The tests all depend on what is occurring at a particular time so a repeated test may give more accurate information or it may reiterate the previous results. A seizure happens so quickly that often a doctor will not ever see the patient seizing. (WebMD.com) If a person is diagnosed with epilepsy then a neurologist will prescribe a medicine or treatment plan. Typically it takes a while to find the right medicine or combination of medicines for the particular person's case. Sometimes medicines do not work at all. A treatment plan could consist of a ketogenic diet, vagus nerve stimulation, brain surgery, or investigational treatments. There is no overall cure for epilepsy because it is so complicated and unique. (Lindberg)

The EEG machine is a very young device at only 85-years-old and is becoming more and more advanced everyday. (Zifkin 30-31) Even with the enhancements and inventions such as the CT and MRI scans, EEGs are still used everyday. Epilepsy is just

one disease EEGs are able to diagnosis. I chose the topic because it related to me personally and I am interested in the field of medicine. As stated above, it takes years of research and tests to invent anything. Seizures are very personal and complicated experiences that are over so quickly. They are trick to diagnose so I'm interested to see what the future has in store for the 60 million people that have epilepsy at any one time. (Lindberg) (WebMD.com)

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