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## Learning Through Storms

When discussing learning, we sometimes refer to cognition, or one's ability to think, learn and use information. Seizures can impact cognition, learning and behaviour in a variety of ways. What follows is a discussion of the important factors that play a role in learning, and some strategies to help people with epilepsy learn as well as they can.

### Factors:

#### 1. The cause.

For any given individual, the cause of epilepsy has the greatest influence on learning. The International League against Epilepsy (ILAE) describes three different causes of epilepsy and epileptic syndromes:

##### (i) Symptomatic

There is a known brain disorder or brain damage. For example, brain damage from meningitis, encephalitis, or severe head trauma, a disturbance of brain development, conditions such as tuberous sclerosis, Down Syndrome, Tay-Sach's disease, etc.

##### (ii) Cryptogenic

Where one of the disorders listed above is suspected but not proven.

##### (iii) Idiopathic

There is no brain disturbance apart from the epilepsy itself.

The majority of people with epilepsy will have idiopathic epilepsy, involving no brain damage. Those who have symptomatic or cryptogenic epilepsy are very likely to have problems with learning and behaviour simply because these conditions are associated with more disturbance to the brain. On the other hand, those who have idiopathic epilepsy are very likely to have average to above-average learning ability.

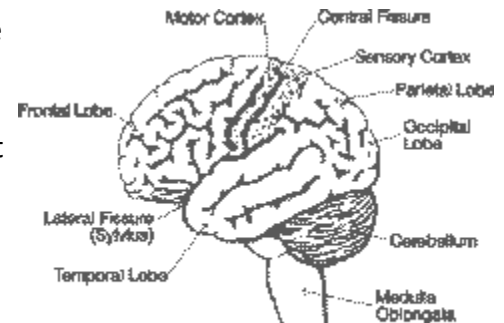
#### 2. Area of the brain affected by the seizures.



When seizures consistently begin in a particular area of the brain, functions controlled by that part of the brain can be affected. Readers are encouraged to visit the following website, which gives clear explanations of various brain regions:

<http://www.neurosurgery.org/health/patient/answers.asp?DisorderID=51>

This section discusses only the effects of seizures beginning in the frontal and temporal lobes on learning, as there is very little information on the effects of activity in the other lobes. Keep in mind that the amount of brain tissue affected suggests the extent of the seizures' effects on learning. Not all people with seizures beginning in these areas will have these difficulties.



### **(a) Temporal lobe**

#### **i) Left temporal lobe focus**

*Possible difficulties:*

- Verbal memory - Most studies show poor long-term memory for verbal material but average to above-average memory for visual material. Studies have shown that as many as 42 per cent of individuals with seizures beginning in this area will have difficulty with verbal memory, especially word learning.

#### **ii) Right temporal lobe focus**

*Possible difficulties:*

- Visual memory - This includes spatial, visuo-spatial, and nonverbal memory.
- Face recognition - As the processes that control facial recognition are primarily located in the right temporal lobe, seizures here can also impair a person's ability to recognise and remember faces. One's ability to recognise patterns can also be affected.
- Odour recognition and memory for nameable smells - The primary olfactory cortex, which controls our sense of smell, is located in the temporal lobe, and its functions can be disrupted should a seizure occur in this area.

### **iii) Both temporal lobes**

#### *Possible difficulties:*

- Memory impairment - These memory impairments can have a negative impact on learning, making it difficult to progress academically and to function from day-to-day without extra care and memory strategies.
- Behavioural or Personality Disturbances - The limbic system which is intensely involved in emotion, aggression, and the fear response is located in the temporal lobe and may be affected by seizure activity.
- Fine motor skills.

### **(b) Frontal lobe**

#### *Possible difficulties:*

- Planning and organization abilities
- Attention and concentration
- Concept formation
- Decision-Making
- Inhibition
- Anticipatory behaviour
- Formation of concepts
- Motor coordination - Motor abilities can be affected by frontal lobe seizures, and these difficulties are usually worse when seizures begin on the left side of the frontal lobe.

Single case studies have reported the following:

- Perseveration - This is the inability to switch from one line of thinking to another. Often, individuals do the same task for a long period of time because they are fixated on that step and cannot move on to the next. In particular, this behaviour leads to difficulties with step-by-step processes such as arithmetic.

- Speech production - Difficulties with speech may be due to the situation of Broca's area in the dominant frontal lobe. Broca's area functions to change thoughts into spoken language.

### **3. Epileptic syndromes and types of epilepsy.**

#### **Idiopathic Generalized Seizures**

Generally, individuals who have idiopathic generalized epilepsies (e.g. benign neonatal, simple febrile, childhood/juvenile absence, juvenile myoclonic, and idiopathic grand mal) and benign partial epilepsies of childhood, are intellectually average. However, recent studies suggest that some people with these conditions may show 'subtle' disturbances of learning functions that can cause challenges at school and affect attention.

Generalized seizures can, but do not always, affect memory, mental speed and flexibility, planning and organization, language, concentration, abstract reasoning, decision-making, inhibition, perceptual abilities, and anticipation. Because generalized seizures affect the entire brain, any cognitive ability could be subtly affected by them. Those with generalized seizures tend to have more learning difficulties than do those with partial (focal) seizures. Generalized tonic-clonic or grand mal seizures are associated with more difficulty than generalized absence seizures.

#### **Specific Epileptic Syndromes**

Conditions such as Infantile Spasms, Lennox-Gastaut Syndrome, most of the myoclonic epilepsies, epilepsy with continuous spike-waves during slow sleep, Landau-Kleffner syndrome are often (but not always) associated with significant impairment of learning and behaviour. Once again, those whose conditions are "idiopathic" are less likely to have learning difficulties than those who have a symptomatic basis of their epilepsy.

### **4. Seizure frequency, severity, and duration**

For each individual the effect a seizure has on their academic abilities and brain functions will be different. Two individuals of the same age, sex, on the same medication, with the same seizure type, frequency, and severity may react differently to seizures. Thus, one person may develop difficulties learning and retaining information while the other remains at average or above-average levels of academic achievement.

Some children with poorly controlled seizures may show a decline in IQ; however, this decline is not necessarily permanent. If seizures continue to be severe, over time academic achievement will remain slightly lower. However, if seizure severity or frequency decreases, level of achievement may, and in many cases does, increase. Teachers must realize that even if there is improvement in seizure control and the child seems able to function well academically, that child may have to re-learn much of the material already covered in order to make up for the learning that was disrupted by the seizures.

Many studies show that people with inactive or low-severity epilepsy are average or above-average in reading, mathematical, and language abilities. Only in high-severity cases do differences in these abilities become apparent.

## **5. Age.**

In general, the earlier in life seizures begin, the more likely that learning and behaviour will be affected. Parts of the child's brain continue to develop until just before adolescence, so functions attributed to these developing parts may be disrupted by seizure activity. Children with epilepsy should be assessed for learning difficulties, especially if their seizure cause is symptomatic or their seizures are severe and frequent.

## **6. Psychosocial Factors.**

Learning difficulties associated with epilepsy are affected by a variety of social and psychological factors. Some of these factors include family attitudes towards epilepsy and those living with epilepsy, family relationships, expressed emotion and communication of feelings and attitudes, expectations of those with epilepsy, and self-esteem.

The individual's environment (at home and in society), thus plays a key role in learning. Positive social support networks are crucial for those with epilepsy in order to lessen the emphasis of these psychosocial factors on learning and cognition. Society's negative attitudes towards people with seizures (especially children), and the stresses placed upon them at school, in their home (for example, parental separation), or in their work environment can contribute a great deal to disturbances in mood, behaviour, and ability to function.

For school-age children, seizures at school can be socially challenging, detrimental to self-confidence and self-esteem. Peer education can improve both quality of life and academic performance, by reducing problems like ridicule and fear from classmates. Teachers and parents need to be aware of the psychosocial influence of epilepsy on a child's academic success and adjustment to the school atmosphere.

## **7. Anti-epileptic drugs.**

As long as sound, common sense principles are followed, anti-convulsant drugs are unlikely to be primarily or exclusively responsible for cognitive or behavioural dysfunction in those living with epilepsy. We are not aware of any drug that is guaranteed not to have cognitive or behavioural side-effects. However, the side-effect profiles are different amongst the various drugs. The majority of those with epilepsy will be controlled on one anti-epileptic drug and function well. A few may require two. Fewer still may require three or four. The benefits of any combination must be weighed against the potential adverse effects, including those on cognition and behaviour, which are more likely to occur with polypharmacy (use of multiple drugs for treatment). On the next pages you will find a table indicating major anti-epileptic



drugs and known cognitive side-effects. Keep in mind that not everyone experiences these side-effects and that they are usually most apparent at higher doses.

One is more likely to have negative side-effects if more than one drug is used. Furthermore, 'herbal remedies' should be used only with a great deal of caution as they can interact with prescribed drugs and further disturb learning.

In general, the newer anti-convulsant drugs have a much smaller negative effect on learning than the 'older' ones (e.g. phenobarbital, benzodiazepines, etc.), but they may have other side-effects. Individuals with epilepsy should discuss the treatment options for his or her situation with their physician. Because everyone responds differently to a given drug, every case is unique.

(List of meds)

## **8. The Ketogenic diet.**

The ketogenic diet has been used in the treatment of epilepsy for almost 90 years. By itself, it does not have any negative effects on learning or behaviour. If it is effective, then one may be able to reduce the dosage or number of anti-epileptic drugs taken, with a potential for improving learning.

## **9. Surgery.**

In the majority of cases, improvement in function occurs as a result of a reduction in seizures and a reduction in anti-epileptic drugs. Cognitive function may be affected if important areas of the brain have to be removed during the surgery or if the surgical procedure itself causes damage to the brain. Though there are some drawbacks and risks involved in surgery for seizures, the benefits seem to outweigh the few cognitive deficits that are sometimes reported. Space does not allow us to discuss the role of surgery in epilepsy. Clearly, all those who have intractable epilepsy should be evaluated to determine if they would benefit from any surgical procedure.

## **Learning Strategies:**

### **1. Memory.**

When it comes to learning, the most common difficulty for those with epilepsy is problems with memory. Whether these problems are caused by the seizures or by general mental slowing from the epilepsy medications, these memory problems can make learning very frustrating for a person with the disorder. Understanding of these difficulties by teachers and parents is crucial for effective learning experiences and supportive learning environments.

Strategies to improve memory skills include:

- Visual demonstrations and diagrams (especially if the seizures begin in the left temporal lobe).
- Colour-coded notes or high-lighting to better categorize material.

- Word associations with pictures or smells.
- Mnemonic strategies (verbal strategies such as this are helpful for seizures beginning in the right temporal lobe).
- Verbal repetition.
- Rhymes and songs.
- Active participation with the material that is trying to be remembered (e.g. asking questions, giving examples, etc.).
- Learning to stay calm when memory blanks – when you are calm information is more likely to come back to you.

Generally speaking, things will be remembered more easily if they are well-organized and separated into logical groups or categories. In other words, it is easier to remember a list of words if one separates them into, for example, fruits, vegetables, items of clothing, colours, etc.

To remember daily activities and appointments, simple aids can be used such as diaries, post-it notes, calendars, or computer-based aids such as a Palm Pilot.

## **2. Organization and Planning.**

For individuals with frontal lobe epilepsy and sometimes generalized epilepsy, planning and organization can present problems. Some strategies to improve these abilities include:

- Establishing a routine.
- Using reminders and diaries to organize their day.
- Developing time management strategies, and schedules.

**In a study of 18 adults with epilepsy, it was found that a drug called donepezil improved some aspects of memory. This is a new study that has yet to be replicated and seizures may be worsened by the use of this drug.**

## **3. Attention.**

In all forms of epilepsy, maintaining attention and concentration can be challenging. Regardless of whether this is due to the epilepsy medications or due to the seizures, it does present a barrier to learning.

Some strategies to improve attention include:

- Removing potential distractions from the surrounding environment (for example, avoid placing a child in a seat located close to a doorway, window, clock, or too far back in the classroom).
- Use material that the individual is interested in.
- Encourage goal-directed behaviour. This can be done by using reinforcements and rewards.

#### **4. Stress Management.**

Stress management techniques may help students of all ages. Seizures are often aggravated by stress, and school is inevitably a stressful experience. We can reduce the effects of stress on seizures by supplying the individual with relaxation techniques and stress outlets like exercise and music. We can also emphasize the importance of regular sleeping patterns, nutrition, and positive attitudes. Test-taking behaviour will be improved and test-anxiety will be lessened, with a positive impact on the individual's education.

Educators and parents must realize the extent to which epilepsy can affect learning and cognitive functioning. With their support, flexibility and creativity, people with epilepsy can thrive academically. Epilepsy may create obstacles, but they are not insurmountable.

Conclusion:

A number of factors can have a negative impact on learning and behaviour in those with epilepsy. The cause of the epilepsy is the primary factor; however, the type of epilepsy, area of the brain, severity and frequency of seizures, anti-epileptic medications, and psychosocial factors all play a role. Arguably, the influence of society on adjustment may play a more important role than previously thought. Perhaps simple awareness of the effect epilepsy can have on learning and functioning will help reduce the influence of these psychosocial factors in the future.

Though the information presented here may seem overwhelming and discouraging, we must remember the reality of the situation: most people with epilepsy are academically, intellectually, and socially average or above-average. Over 80 per cent of those with epilepsy function effectively in society, have their seizures completely controlled, and eventually come off treatment, suffering very few learning or behaviour problems. For those who face learning challenges, the burden can be reduced through proper assessment and creation of appropriate learning strategies. With the support of others, these challenges associated with epilepsy can become strengths.



