

Epilepsy and Neuropsychology

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Most people living with epilepsy do not experience serious problems with their thinking. However, there are aspects of thinking that can be affected by recurrent seizures and/or their treatments. This article focuses on the types of thinking problems most commonly seen in people living with epilepsy, why these problems may occur, and what can be done to minimize the impact of thinking problems on one's day-to-day life.

What is Neuropsychology?

Neuropsychology is a specialty area of psychology that focuses on thinking, learning, and behaviour and its relationship to the brain. Neuropsychologists often work closely with neurologists and other health care providers to identify how a neurological illness or injury may be affecting functioning in day-to-day life. Neuropsychologists use standardized tests to examine different aspects of thinking (such as memory, attention, and problem solving) and behaviour to better understand a person's individual profile of abilities and challenges (strengths and weaknesses). With this information, a neuropsychologist can identify brain structures or systems that may not be working efficiently and make suggestions for treatments or supports that can help a person function to maximum capacity. A person living with epilepsy may be referred to a neuropsychologist if they are noticing problems with their ability to learn and remember information, pay attention and focus, finish projects, express themselves clearly, etc. It is also common for people who may have surgery to treat their epilepsy to have a neuropsychological assessment before and/or after their surgery.

Why are people diagnosed with epilepsy at risk for neuropsychological problems?

Our brains control our thinking, behaviour, and emotions. When a person has recurrent seizures, there is a chance that brain functioning may be disrupted and cause problems with the ability to process or remember new things, pay attention, control one's behaviour or reactions, and/or affect one's mood. When evaluating how seizures can influence one's neuropsychological function, several factors need to be considered:

- 1) The type and location of seizures in the brain. There are several different types of epilepsy syndromes and each can have a unique pattern of thinking difficulties associated with it. A person who has absence seizures is likely to have a different pattern of neuropsychological problems than a person who has temporal lobe epilepsy. Some epilepsy syndromes are considered relatively benign and have very little effect on thinking skills. Other types of epilepsy are more severe and are associated with more significant neuropsychological impairment.

Our brains are highly organized and different brain regions are associated with different types of thinking abilities. Depending on where in the brain the seizures start and where in the brain the seizures spread to, there can be problems with different types of thinking. For example, a person who has seizures in the left temporal lobe may have a different pattern of thinking problems than a person who has seizures coming from the occipital area of the brain.

- 2) The frequency and severity of seizures. People with more frequent and severe seizures or people who have seizures that are very long (status epilepticus) have a greater chance of experiencing changes in their thinking than people who have infrequent brief seizures.

- 3) Length of Illness. The longer a person has been having seizures, the greater the chance of thinking difficulties. Seizures that begin in infancy are known to be particularly harmful to thinking abilities, in part because the brain is still developing and the seizures are affecting the way the brain develops. People who start having seizures in childhood are more likely to experience thinking problems than people who start having seizures as an adult. In general, the longer a person's brain can develop and be healthy before the seizures start, the less risk that the seizures will affect one's thinking abilities.
- 4) Medications. There are many different medications used to treat epilepsy, each with their own side effects. Some anti-epileptic medications are known to have specific effects on thinking. Most medications for epilepsy can cause drowsiness or slowed thinking. Often times, these problems are short-lived and go away on their own. It is important to talk with your doctor if you feel your medications are interfering with your ability to focus or think clearly.
- 5) The underlying cause of the seizures. People have seizures for many different reasons. Some people with epilepsy have subtle abnormalities in the way their brains are structured or the way their brains function. For others, seizures are the result of some kind of acquired brain injury (e.g., stroke, infection, head injury). The underlying cause of a person's seizures is the best predictor of the type and extent of thinking problems a person may experience. While seizures and medications can cause changes in thinking, most thinking problems associated with epilepsy are best explained by the cause of the epilepsy itself.

What types of thinking problems are commonly experienced by people diagnosed with epilepsy?

The majority of people diagnosed with epilepsy have seizures that originate in the temporal or frontal lobes of the brain. These brain regions are responsible for many important aspects of thinking. For example, the temporal lobes are very important in the formation of new memories, whereas the frontal lobes help us regulate our thinking and behaviour. The frontal and temporal areas of the brain have strong neural connections that support communication between these two regions and with the rest of the brain.

Because the temporal and frontal lobes are often implicated in epilepsy, the most common thinking problems associated with epilepsy are thinking skills controlled by these areas of the brain. The following is a list of the 5 most common types of thinking problems associated with epilepsy, all of which are mediated by the frontal or temporal lobes of the brain:

- 1) Attention. Attention is a foundational neuropsychological function, mediated by the frontal lobes. Before one can process, learn, or respond to something, one must first focus and attend to it. Problems with attention can undermine all other aspects of thinking and learning. There is a high incidence of attention problems in people who have seizures. Attention problems are also a common side effect of anti-epileptic medications.

There are many aspects to attention, but the aspects that are most relevant to epilepsy have to do with the ability to focus and concentrate on something while ignoring distractions (ie, selective attention) and the ability to sustain focus and concentration over long periods of time (ie sustained attention). People with selective attention problems are likely to be easily distracted and have trouble ignoring non-relevant stimuli (e.g., ignoring a police siren when listening to a lecture). People with sustained attention problems tend to have trouble finishing longer tasks and can be prone to day dreaming (e.g., starting projects but not finishing them). As many as 40-60% of children with epilepsy have attention problems.

- 2) Executive Functions. Executive functions are a group of skills involved with regulating our thinking and behaviour. Executive functions guide our problem solving and decision making

and are crucial for successfully managing more complex tasks or ideas. Skills that make up the executive functions include: organization and planning, self-monitoring, the ability to sequence, the ability to shift or switch ideas or plans if something is not working, the ability to persist or carry-through on something, and the ability to inhibit or stop oneself from doing or thinking something. As its name suggests, executive functions serve as the “executive” of the brain and allow us to be more efficient and effective thinkers.

Executive functions are mediated by the frontal lobes of the brain. Like attention, problems with executive functions can undermine all other aspects of thinking, particularly more complex thinking. Executive functions develop slowly through childhood and are not fully developed until late adolescence or early adulthood. Thus, problems with executive functions are not often recognized until a child is 8-10 years old or older. People with executive function problems may be impulsive, messy, lose track of their belongings, have trouble multi-tasking or working efficiently, procrastinate, or have trouble finishing projects. Problems with executive functions can result in reduced productivity or success in work situations.

People with epilepsy are at high-risk for executive functioning problems, particularly those who have seizures originating in the frontal lobes of the brain. Certain medications can also affect executive functions.

- 3) Learning and Memory: The most common thinking problem reported by people living with epilepsy is poor memory. The formation of a memory and the retrieval of information over time involve multiple areas of the temporal and frontal lobes. Problems with certain aspects of memory can result from disruptions to specific temporal or frontal brain areas.

Learning and memory is a multi-staged process involving the (1) encoding of information, (2) storage of information, and (3) retrieval of information over time. A breakdown at any stage results in poor memory, but for different reasons. For example, problems with encoding or creating a new memory can result from inattention or problems with executive function. If a person did not focus on the information to be learned or could not process it efficiently, he or she is less likely to form an accurate or complete memory of the information. Similarly, disorganized thinking can greatly impede a person’s ability to retrieve or recall previously learned information. Think of memory as a file cabinet—if the information is stored in a disorganized way, it makes it much harder to find it later when you need it. If a memory is not stored in a logical or organized way, it will be much harder to remember it accurately later.

The middle stage of memory, the “storage” stage, is the stage when we take the new information we have just learned and file it away in our “file cabinet.” This is the stage when we put information into our long-term memory. The ability to form long-term memories is controlled by a brain region called the hippocampus, which is found deep in the temporal lobe of the brain. There is one hippocampus in each brain hemisphere. The hippocampus in the left temporal lobe is responsible for forming language-based memories and the hippocampus in the right temporal lobe is responsible for forming picture-based memories.

People with temporal lobe epilepsy are at risk for memory problems because temporal lobe seizures commonly involve the hippocampus or the areas immediately surrounding it. For people who have frequent or severe seizures in the temporal lobe, there might be damage to the hippocampus, making it more difficult for new long-term memories to be formed. If one hippocampus is not working well because of seizures, the other hippocampus is often able to compensate. Thus, it is rare for a person with epilepsy to have severe problems forming any new memories.

- 4) **Speed of Processing**: Speed of Processing refers to how quickly a person can process and absorb new information and respond to it. Recurrent seizures and seizure medications can slow a person's speed of processing. When processing speed is slowed, it can feel as if everything is on "fast-forward" and a person can have trouble keeping up. People with processing speed problems benefit from having things presented to them more slowly. They also benefit from repetition and review to ensure they have processed information fully. People with processing speed problems can also struggle to get their ideas out quickly and many need extra time to complete jobs or assignments.
- 5) **Information Processing**: Information processing refers to how people understand and make meaning of the information they hear or see. Broadly speaking, there is language-based processing (understanding language) and visually-based processing (understanding visual images). People with seizures in the left hemisphere of the brain are more likely to have language-based processing issues. They may have trouble understanding what someone is saying to them or struggle to use the right words to express themselves. People with seizures in the right hemisphere of the brain are more likely to have visually-based processing problems, which can make it difficult for them to see patterns in designs or details in pictures.

What can a person living with epilepsy do to minimize the impact of neuropsychological challenges on day-to-day functioning?

It is important that anyone living with epilepsy who is experiencing problems with thinking talk to their doctor. The doctor can attempt to sort out the possible reasons for the thinking problems. It may be necessary to undergo additional diagnostic procedures such as blood work, additional EEGs, or brain imaging. The doctor may also refer a person with thinking problems to see a neuropsychologist. A neuropsychologist has specialized expertise to identify the nature and type of thinking problems a person may be having. The neuropsychologist can be very helpful in identifying strategies and interventions that can support a person's unique profile of neuropsychological strengths and weaknesses.

If a person is having mild-to-moderate problems with attention, executive functions, or memory, there are several adjustments one can make in daily life to support oneself. The following is a list of general recommendations. Some may be more helpful than others, as different methods may work for different people and different problems. These strategies only work if you use them. It may take longer to do things while you are learning how to apply new strategies.

Strategies for Supporting Attention and Executive Functions

- complete important work in a quiet, distraction-free place
- give yourself well-timed rest breaks after long periods of concentration
- have set start and stop times for work
- increase the structure in your environment and follow routines
- break big projects down into smaller parts and do a little bit at a time
- apply organization strategies (e.g. making lists, outlines) to structure your work habits
- give yourself extra time to get things done
- avoid multi-tasking

Strategies for Supporting Learning and Memory

- be active in your learning (visualize, write it out, repeat, review); don't assume you will remember something
- try to relate new information to something you already know; try to make it meaningful
- pace yourself: don't try to learn too much at once
- use mnemonic cues such as rhymes or acronyms to remember things
- keep lists or a journal to remind yourself of important information

General Strategies for Optimal Thinking

- relax; reduce your stress
- get plenty of sleep
- eat nutritiously
- exercise regularly

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