



Epilepsy and Neuropsychology

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Most people living with epilepsy do not experience serious problems with their thinking, although memory complaints may be quite common. There are aspects of thinking that can be affected by recurrent seizures and/or their treatments. This article describes 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 their impact on one's day-to-day.

What is Neuropsychology?

Neuropsychology is a specialty area of psychology that focuses on the relationship between cognitive functioning, behavior, and the brain. Neuropsychologists often work closely with neurologists and other health care providers to identify how a neurological illness or injury may be affecting day-to-day functioning. Neuropsychologists use standardized tests to examine different aspects of cognitive functions such as attention, memory, language, and executive functions. Understanding a person's individual profile of cognitive strengths and weaknesses can help a neuropsychologist to identify brain systems that may not be working efficiently and make suggestions for treatments or supports that can help a person maximize their daily functioning. 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 considering 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, disruptions in brain functioning affect their ability to process or remember new things, pay attention, control their behaviour or reactions, and/or affect their 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. 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 prolonged seizures (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.

Some studies have examined the impact of chronic epilepsy in older adults. The researchers found that older adults who have been living with epilepsy have worse memory than healthy older adults, but their memory problems are not necessarily as bad as someone who has dementia. Poor seizure control and use of multiple AEDs generally increase the severity of memory impairment in older adults with chronic epilepsy.

- 3) The underlying cause of the seizures. Seizures can arise from many different reasons. Some people with epilepsy have subtle abnormalities in the way their brains are developed. 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.
- 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.

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. The frontal and temporal areas have strong neural connections that support communication between these two regions and with the rest of the brain. These brain regions are responsible for many important aspects of thinking. 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).

- 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 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.

Can mood problems affect cognitive functioning?

People living with epilepsy are also susceptible to mood and anxiety disorders such as depression. Depression and anxiety can result from having to deal with the limitations of living with epilepsy, but it can also be due to the chemical changes associated with epilepsy. Seizures arising from the temporal lobe cause emotional problems because the temporal lobe is part of the emotion circuit. When people are depressed and anxious, they may be preoccupied with their internal experience; their minds may be wandering and/or distracted by ruminative thoughts; and they may neglect to pay attention to the tasks at hand. Subjective memory complaints may also arise because people with depression are more likely

to focus on everyday memory lapses that are also common in healthy individuals. Once depression is treated, subjective memory complaints usually go away.

Will surgery affect cognitive functioning?

If the seizures are uncontrollable by medications, brain surgery may be considered. The type of thinking problem that may arise from surgery depends on the location of the brain resection and presurgical functioning. It is common to expect some memory changes in the early postsurgical recovery period, although the nature and severity of memory loss depends on each individual case. That is not to say that the person will awake from surgery not remembering anything about their childhood or family members. After temporal lobe surgery, a person may have trouble forming new memories such as recalling recent conversations and events. Difficulty with route finding may be expected if the surgery took place in the non-dominant part of the brain (typically on the right side). In addition, a person may experience difficulty with finding words if the surgery took place in the dominant part of the brain (typically on the left side). With frontal lobe surgery, changes in executive functions may be seen.

Interestingly, research suggests that seizure control and emotional health are most predictive of memory complaints. Emotionally healthy individuals who achieved seizure freedom after surgery are least likely to complain of memory problems even when there is objective evidence of memory changes. In fact, with seizure-freedom, people often report that they can focus better and that their thinking is clearer than how they felt before the surgery. Just imagine that your brain is a big office building and the seizure generator is a noisy neighbor. No one can work effectively when there is a noisy neighbor. Once you evict the noisy neighbor, all the other neighbors can now work peacefully.

What are some compensatory strategies?

- Smart phones have several useful functions: use the calendar to keep track of appointments, and alarm reminders for medications. The voice recorder and camera functions can also be used to quickly record shopping lists. Google Keep is a free app that offers all of the above functions.
- Practice the Method of Loci: imagine a familiar location such as your living room. As you mentally walk around the living room, mentally place your grocery item on each piece of furniture in your living room. When you get to the grocery store, mentally walk through your living room in the same way and “retrieve” the items.
- Active learning: draw graphs or pictures, write notes/summaries as you read, make mind maps, make associations, repeat, repeat, repeat.
- Use mnemonics for names or create a story around the person using visual cues as well as unique features of the person; the richer the better. For example, when you meet a new person, create a relevant story in mind about the person’s name (“Tall Tom is the funny accountant with curly brown hair”).
- Identify one “memory” place for all personal items such as glasses, wallet, and keys.
- Reduce distractions and avoid interruptions: complete important tasks in a quiet environment (e.g., turn off the radio or TV) to reduce environmental or visual distracters (e.g., cluttered workspace). Use a “do not disturb” sign if you live in a busy household.
- Managing fatigue: As soon as you begin to feel overwhelmed, take a short break – the sooner the break, the faster you will be able to get back to what you were doing and be effective, but don’t push yourself so hard that you get frustrated.

- Goal management: start by defining the main task. Break down the task into small chunks and write down the steps required to complete the task in a list format. Execute task and do not re-write steps. Stick with the steps listed instead of re-writing them. Finally, check by asking “am I doing what I planned to do?”
- Addressing mood and anxiety issues can also help improve subjective sense of cognitive problems.

Regardless of the strategy you choose, the key to successful implementation of compensatory strategies is practice, practice, practice.

What else can you do to protect brain health?

The current research shows that the best thing anyone with a neurological condition can do to protect their cognitive functioning is to stay physically active. Physical aerobic exercise that gets your heart rate going, such as brisk walking, stationary biking, or running are excellent for promoting brain health. In general, just remember that anything that is good for your heart is also good for your brain. Whatever you choose to do, check with your physician prior to starting any exercise regimen, and ensure you practice seizure precautions.

Other factors are also protective of brain health. Healthy diet comprising of fresh produce and foods high in anti-oxidants and/or omega-3 fatty acids such as nuts, berries, olive oil, and fish are excellent for promoting brain health. Proper hydration and adequate sleep, as well as social and cognitive engagement are also important. Good sleep hygiene practices include 1) going to bed and waking up around the same time every day, including the weekends, 2) avoiding caffeinated products before bedtime, 3) avoiding stimulating activities or conversations a few hours before bedtime, and 4) making sure the bedroom is dark, quiet, and cool enough for a good night’s sleep.

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 type of thinking problems a person may be having and the possible contributors. The neuropsychologist can be very helpful in identifying strategies and interventions that can support a person’s unique profile of neuropsychological strengths and weaknesses.