# Memory Loss: The most common side effect of Traumatic Brain Injury


Memory loss can affect us all—young and old. We all forget things at times. Forgetfulness can happen because of a busy lifestyle, depression or as a side effect of old age.

However, memory impairment can also be a result of a traumatic event such as a brain injury or as a side effect of Alzheimer's or dementia.

An article by the National Institute of Neurological Disorders states: "the most common cognitive side effect of traumatic brain injury is memory loss."

**Memory impairments in everyday life**

Memory loss may negatively impact an individual's ability to perform activities of daily living and function as independently as they did prior to the impairment.

It may also impact an individual's ability to work, remember work-related appointments or remember co-workers names.

Most importantly, memory impairments may impact an individual's safety within the home or community. An individual suffering from memory loss may forget to turn off the stove after cooking, or may even get lost in the community and be unable to return home.

**What is memory?**

Memory is the retention of learned information. It differs from learning in that learning is simply the acquisition of new information. It is retention that clearly differentiates learning from memory.

Memory involves a 'set' of skills including acquisition, storage and retrieval of information. Though seemingly simple and something we often do without 'thinking,' the process is related to and crosses all cognitive and emotional domains. It is our dominant cognitive process. It allows one to retain and recall information, personal experiences and procedures.

**How is memory formed?**

This is a fair question to ask, but one without a solid answer. Despite years of research, scientists continue to debate the neuro-anatomical process of memory. A variety of theoretical models and constructs have been proposed but with no definitive system to detail exactly how we create a memory. Though the process of creating memory is still a mystery, the anatomical structures involved are well known.

Memory is reliant on three systems: activation system, limbic system, and cortical system.

**Activation** is gained at the brain stem level. It is the most basic component and is necessary for information processing and perception. It is the attention center. Damage to the brain stem may result in coma, and thus a disruption of the activation process. Above, but not directly in the brain stem, is the diencephalon. The diencephalon houses the thalamus and hypothalamus. The hypothalamus is responsible for our emotional memories, like a first love, recall of anxiety felt the first day of a new job, or a special holiday memory.

The second component, the **limbic system**, is directed toward needs. It allows for behavioral, arousal, and emotional regulation. The limbic system includes the amygdala, basal ganglia, and the hippocampus. It is where consolidation of material to store into memory is initiated. The hippocampus is a paired organ that sits within the temporal lobes. It is responsible for moving short-term memory into long-term memory. The amygdala, like the hypothalamus, is involved with emotional memories, specifically our fight or flight response, which allows us to react quickly based on an emotional evaluation of the input. The basal ganglia relays information involving physical movements from the cortex to the cerebellum. It is responsible for motor skill memory, such as riding a bike.

The final system is the **cortical system**. This system registers and stores memory. It completes the task of information processing by distributing information according to modality (visual, auditory, somatosensory) and material (verbal vs. non-verbal). The prefrontal cortex allows for goal direction, is involved in working memory and learning from consequences.

**Transient Memory Disruption**

Transient memory disruption involves a period of time or a particular state during which an individual has a severe deficit in the ability to take in, encode, store or retrieve information. As the name implies, it is a reversible state, following which the memory recovers or substantially improves.

## Memory Loss *continued*

A post-traumatic amnesia state is just one of many forms of transient memory disruption. A variety of toxic and metabolic conditions and vitamin deficiencies may also result in reversible memory disruption. These include, but are not limited to, hypoglycemia and vitamin B1, B6 or B12 deficiencies – conditions that occur with certain diseases and under situations of neglect or poverty.

A variety of pharmacologic agents including the major anesthetics benzodiazepine and scopolamine, or other cholinergic antagonists, disrupts active memory storage for periods of time.

Acute alcohol intoxication and focal transient ischemic attacks (minor stroke) involving memory structures may also result in transient amnesias. During temporal lobe or generalized seizures, and in the postictal state, there is commonly a loss of memory for events. In patients undergoing electroconvulsive therapy, there is usually memory loss for the period just prior to, during, and following administration. During a wide variety of psychoemotional states, including depression, there can also be a transient disruption of memory capacity that is reversible with recovery to a more normal emotional state.

In transient amnesia, memories are not typically regained for the periods during which memory systems were dysfunctional, but individuals can recover the ability to store new memories when the condition reverses.

**Permanent Memory Disruption**

There are a variety of conditions that result in more persistent, pervasive or progressive kinds of memory loss. Many individuals who have experienced head trauma have a primary memory deficit – a significant restriction in their ability to store new information. Persons may also experience memory problems as the result of attentional deficits or information-processing limitations that affect earlier stages of the memory system. Variable kinds of memory disruption following head trauma probably reflect the extent and focus of lesions.

Chronic alcohol abuse that develops into Korsakoff's syndrome is associated with destruction of the mammillary bodies and dorsomedial nucleus of the thalamus. The result is severe chronic amnesia.

Many hypoxic or anoxic conditions seem to have rather specific influence on at least the most debilitating effects on the memory structures. Different parts of the brain vary in the need for oxygen. The hippocampus with its high metabolic rate, has a high oxygen demand; if there is a disruption in available oxygen, the hippocampus is more likely to be damaged than other parts of the brain. Damage to the hippocampus can result in disruption of long term memory storage.

In infectious disease, the virus attacks particular structures in the brain resulting in memory disruption. Disease processes in which recall is affected include herpes simplex encephalitis and degenerative diseases such as Alzheimer's disease. With herpes simplex encephalitis, the mesial temporal lobe including hippocampus and mammillary bodies and the orbital structures of the frontal lobes are impacted. The result may be a pervasive chronic amnesic disturbance.

Degenerative diseases affect multiple brain systems and have memory impairment as a cardinal feature. Whenever there is bilateral temporal lobe damage, whether it is from a disease, lesion, surgical intervention or any combination, there is a strong likelihood that primary memory systems will be disrupted.

**Improving memory**

Steven Rose, head of the Brain and Behavior Research Group at the Open University, stated, "Memory is often not so much lost as hard to find."

However, much research suggests that memory loss due to damage to the brain does not improve. Once the brain is damaged, it is damaged, but memory can improve if the brain can be retrained to compensate for the loss. Essentially, teaching other parts of the brain to "take over" for those parts of the brain that are not functioning, or compensate for what is lost.

As stated in "Memory Problems and Treatments for Traumatic Brain Injury," Dr. Jennifer McCaine, a psychologist at the Jamaica Hospital Medical Center's TBI Unit explains: "performance might be improved even though the underlying memory ability remains unchanged." Therefore, memory itself may not improve, but an individual's ability to function with memory loss can and will improve through cognitive compensatory training and use of strategies as it relates to daily living skills.❖

***References***

*Brookshire, Robert H. Introduction to Neurogenic Communication Disorders. 5th ed. St. Louis, MO: Moby, 1997.*

*Franklin Institute, The (2008). The Human Brain. Retrieved Janary 18, 2008, from Resources for Science Learning. Website: www.fi.edu/learn/brain/stress.html*

*Gillis, Rita, J. (1996) Traumatic Brain Injury: Rehabilitation for*

# Memory Loss *continued*

*Speech-Language Pathologists. Boston: Butterworth-Heinemann*
*Herrmann, Douglas, and Parenté, Rick. Retraining Cognition; Techniques and Applications. 2nd ed. Austin, Texas, 2003, 25-30.*
*"How the Brain Remembers and Learns." AARP.org 1995-2008. http://www.aarp.org/health/brain/works/what_is_memory.html?print=yes. (9 Jan 2008).*
*"Human Memory". NASA.gov ( 9 Jan 2008). http://human-factors.arc.nasa.gov/cognition/tutorials/ModelOf/Knowmore1.html*
*Malia, Kit B., et al. Brainwave-R: Cognitive Strategies and Techniques for Brain Injury Rehabilitation. Austin, TX: Pro-Ed, 1997.*
*Sohlberg, McKay M., & Mateer, Catherine A. (1989) Introduction to Cognitive Rehabilitation: Theory and Practice. New York: The Guilford Press.*

*Written by Char Combs, OTR and Angie McCalla, MS,CCC-SLP, CBIS; Rainbow Rehabilitation Centers, Inc.* 

*RainbowVisions Magazine*
*Rainbow Rehabilitation Centers, Inc.*
*5570 Whittaker Road, Ypsilanti, MI 48197, USA*
*E-mail: rainbowvisions@rainbowrehab.com*