



# Working Memory and Brain Injury

## What is working memory?

Working memory is our ability to store and process information in the moment. When we listen to a news reader, our working memory is being used to hold information temporarily and to put together what we hear into something understandable. To make the information understandable working memory retrieves other information from memory stores. We also use working memory to remember and compare different solutions when considering a problem. Working memory is therefore a prerequisite for understanding and interpreting what others say and for being able to reasonably make up our own mind. It also gives us the ability to switch our attention between different tasks. Working memory is used during almost all our waking hours.

The amount of information that can be stored and processed in the working memory is limited. However, the capacity of working memory differs from situation to situation. If we create meaning or have an emotional connection to what we hear or read, the amount of information our working memory can store will increase. This is something we do all the time without even thinking about it. It is also possible to make use of this consciously. If we cannot use previous knowledge, the working memory becomes quickly overloaded. When working memory hits capacity, it becomes difficult for us to hold a thread. What we thought, or what was said in the moment before falls away before we have understood it.

Simplified you can say that working memory is like having a notebook. Information is recorded in temporary storage whilst we decide what to do with it, or if it is even important at all. The information is held on the notebook while we retrieve information from other places in the brain. When we have all the information required we can then make reasonable decisions about what to do with the information in temporary storage.

## Brain injury and memory impairments

People with brain injury often experience difficulties that may be attributed to the functioning of working memory. These difficulties can be seen in different ways depending on the individual. Here we describe factors which may cause impaired functioning of working memory.

### To do several things at the same time

To be interrupted when doing a task or doing several things simultaneously is a common situation in everyday life. We need to pause what we are doing to deal with a new task, and then to switch back to the previous task. People with a brain injury often have difficulties with such changes, and the demands of doing multiple things at the same time may cause them to not execute or complete any of the tasks. If a person with a brain injury gets interrupted in the middle of a task, they may have to start over. In conversations, people with a brain injury may find it difficult to keep up with the conversation if the topics changes quickly or often.

## The ability to focus

Since the amount of information working memory can process is limited, it is necessary for us to focus our attention to what is important. We need to be able to shut out things that are less important. If this is not possible, the working memory will soon be overloaded with information.

A common situation where limitations of working memory are noticed is when several people are speaking at the same time. In this situation, we need to choose to listen to one person at a time or alternate quickly between separate conversations, so we can participate in two conversations at the same time. A person with brain injury can find it hard to listen and understand what is being said if several people are talking at the same time.

This also applies when there are other sources of distraction such as noise or an environment with a lot going on, for example, light and movement. When a person with a brain injury has not understood what has been said, they will, in turn, not accurately recall the details of the conversation, which can often be mistakenly interpreted as a memory recall problem.

## When there is limited memory capacity

Sometimes people with brain injuries can have difficulty understanding even though they have good capacity to focus on what is said or what they are reading. It is as if the amount of information that can be kept alive in the moment has been limited. This can, for example, make it difficult to keep different options in mind, and thereby making it difficult to choose.

People with brain injury can also find it difficult to quickly decide what is important and not important in a conversation. Information which is written down is often easier to understand. What we write down can be checked repeatedly, while what is said will disappear as soon as it is said.

One of the reasons for quick overloading of working memory is the person with a brain injury does not have the same ability to make connections between what is said or written to previous knowledge

existing in other memory systems. In these situations, another person can help to repeat and sort the information.

## Slowness

Working memory impairments experienced by people with a brain injury are often associated with slow speed of thinking. In this instance, the person with a brain injury generally needs more time when dealing with information. A reduced speed of thinking leads to difficulties with keeping up with a conversation.

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## What can be done to deal with working memory impairment?

### Training of working memory

There is some evidence which indicates improvements can be made through training working memory. Training of working memory consists of practicing meaningful tasks in a systematic, consistent and specific manner with the aim to improve function. In this instance, the person will get better at exactly what they practice and even possibly on similar tasks, but the training does not give a general improvement in working memory.

### Compensation

Compensation is something we do try to get around impairments. We try to use our strengths in such a way that the impairments give as little problems as possible. To have knowledge and awareness about our challenges is essential for being successful in compensating. If we succeed in finding ways to manage our impairments it often increases our sense of control and the experience of stress decreases.

There is a distinction between internal and external compensation. Internal compensation means we try to find our own way around the problems through strategies in the form of ways of thinking. External compensation means using external support in the form of other persons, adaptations to the environment or aids such as note books, phone apps and diaries.

## Internal compensation

Internal compensation for working memory impairments is mainly about increasing focus on what we do. Striving to do one thing at a time at a reduced pace to the extent that we can manage. If we can create a structure or routine, we can often reduce the strain on working memory.

It is also important to have the right expectation of what we can perform. If we expect to perform at too high level, it leads to frustration, anger and disappointment, which further worsens the ability to focus on what we do or should do.

## External compensation

### To use aids

Cognitive aids are often systems that can help perform the part of thinking the injured brain does not cope with. In the case of working memory, it is the ability to perceive and process information in the moment that is impaired. The aids should be quickly accessible and the information easily available.

There are different types of aids available for working memory impairments. A notebook, a voice recorder, or a recording feature on a mobile phone can help with storing information.

This reduces the requirement to perceive and process the information in the moment. Most mobile phones have many features that can be a help in memory compensation. For example, note pages to write or voice memos to record things to remember, calendar with reminders and timers. Camera for taking pictures of places or written information can be a memory aid. GPS function can be helpful when it is difficult to remember how to get to different places. Additionally, most mobile phones can be customized by downloading specific applications (app), to the phone. An app can be more developed and specialized than the basic applications in the phone. There are a very large number of apps to choose from and finding one that is a good fit can be a challenge.

## Environmental adjustment

Environmental adjustment includes both the adaptation of the physical environment and the support of other people. Environmental adjustment includes reducing distractions for the person to increase focus on a task. Furthermore, a task can be broken down into different parts and done in a timelier manner instead of everything being done at the same time. A person's day can also be planned to ensure there is not too much on to avoid 'overload'.

Adaptations in the physical environment may also include removing unneeded information or setting up the environment to make important information obvious. An example of this is removing unneeded ingredients and equipment from the kitchen bench, leaving only the items necessary for the recipe. When providing written information text should be as easy as possible to read, such as, short and simple sentences and images without long sentences or embedded sentences.

## Help from another person

When the difficulties are extensive and/or when the awareness of the person's own working memory impairments is limited, it is often difficult to use compensatory aids in an efficient and independent manner.

People with brain injury who have less severe impairments can often adapt their environment and make adjustments themselves. For people with more extensive impairment this is more difficult. It will then be the people who are important to the person with a brain injury (relatives, staff, friends, experts) who can organise and make changes to the environment.

To take help from another person has benefits. The help can be provided in a sensitive and flexible manner and adapted to the needs of the individual and their current situation. A knowledgeable and patient support person is often essential if compensatory strategies and devices will be used or not.

## Good physical and mental health

How well we perform with all our thinking skills is related to how well we feel mentally and physically. This applies to all people in all situations. People with brain injuries can often have less ability to cope with stress which impacts on physical and mental health. For people with working memory problems following a brain injury, different stressors may further impact on their working memory function.

Good routines relating to physical activity, nutritional intake, sleep and rest can improve everyday functioning. Reducing anxiety and stress and increasing self-esteem can also increase the ability of the person to function to the best of their ability.

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*The original text comes from Infoteket om funktionshinder, Uppsala County Council, Sweden <https://www.regionuppsala.se/infoteket>*