Memory and reading

Memory and reading are in close interaction with each other. Insufficient working memory capacity or poorly organized long-term memory can cause, for example, difficulties with reading or reading comprehension. The target groups of plain language may have specific memory-related difficulties which increase the challenge of reading.

Working memory is an especially significant memory area for learning to read. Alongside working memory, the information stores of long-term memory are also of importance in learning through reading and reading comprehension.

Working memory means the cognitive processes that maintain information in the mind during active processing of information. Working memory enables the coding, processing and recording of information here and now. Long-term memory in turn is a theoretically unlimited memory store that holds within and organizes everything we know and can do.

Distinguishing and connecting speech sounds and recognizing speech and letter correspondence are central learning tasks at the first stages of acquiring reading skills. Phonological working memory also plays a key part in this. Phonological working memory refers to a process of receiving, analyzing and processing of sound elements in language. Difficulties with learning to read can be connected with either uncleanness of phonological working memory representations (insufficient ability to distinguish phonological differences) or with a fast filling up of the phonological working memory. With the Finnish language, the latter problem is more significant in terms of reading skills, because the sound and letter correspondence is strong, but the words are exceptionally long. It is essential for reading that a child remembers the connection between spoken and written language. The establishment of memory traces makes it possible for a child to remember when hearing or seeing a given speech sound or letter what the matched pairs are. Should the activating of this memory trace in the working memory take a lot of time, it slows down the reading event, makes the memory trace vulnerable to mistakes and, above all, ties up capacity.

Dyslexia research has suggested narrow auditive working memory as one possible reason for reading difficulties. The role of phonological working memory can be difficult to distinguish from the entirety of phonological skills. At present it is commonly agreed, though, that narrow auditive working memory brings further challenges in learning to read and may enhance other causes behind reading difficulties. In practice, poorly functioning auditive working memory impedes, for example, the learning of new phonological combinations and the development of automated reading. Learning new phonological combinations in turn has an important role in learning both native and foreign languages.

As the reading skills become stronger, the functioning of the phonological working memory becomes automated. And as the phonological working memory becomes automated, more room is left in the working memory for understanding the meanings of words and text. A qualitative change in terms of memory takes place at this stage of a child's process of learning to read as a strong activation of long-term memory stores is now needed to support the reading. This also sets new requirements for the functioning of memory so that the long-term memory can function actively, while its contents should support comprehension of the read text. Working memory is however still needed to receive the read information to activate long-term memory.
Impacts of working memory and long-term memory on reading

Reading comprehension and learning through reading thus rely both on working memory and on long-term memory. These required different functional structures of memory can however effect reading comprehension in different ways. Working memory effects the ability to maintain information in the mind at a given moment and to activate long-term memory during reading. Long-term memory in turn effects through its contents and organized structure the ability to understand the applied language and its abstractness as well as pragmatic and other meanings of language.

Problems with working memory hamper especially the processing of long sentence constructions and, through that, their understanding. This problem can be caused by narrow working memory or considerable slowness in reading. Problems and faults in long-term memory in turn make it more difficult to understand the vocabulary used in a text or the meanings of links or references between concepts in language.

Reading comprehension is primarily based on three essential conditions for memory:
1) Mechanic reading skills are sufficient and close to or fully automated.
2) The long-term memory stores are, for example in terms of vocabulary, sufficient for understanding the meanings of a text.
3) Working memory functions effectively enough and in a focused way during a reading event.

An example of the first condition is a starting reader whose processing capacity is mainly bound to mechanical reading. The reader thus can't at the same time effectively process the meaning of the read text. The second condition could refer to e.g. a situation in which the mechanical reading skills are good and automatic, but the words in the text and the referential relations of the sentences are unfamiliar to the reader. A situation like this could be experienced by, for example, a dyslectic child who doesn't have a so-called reading disturbance. The child may learn mechanic reading skills within a normal timeframe, but has difficulties understanding the meanings of words due to dyslexia. An example of the third condition could be attention deficiencies. For example, in ADHD the contents of the working memory are constantly inflicted with extra impulses. Reading comprehension is difficult because there is so much competing information in the working memory during a reading event.

One factor that can make it slower for developmentally disabled people to learn to read is narrow auditive working memory. This is especially true in the case of Down Syndrome. Down Syndrome is characterized by significant problems with reading comprehension. With developmentally disabled people difficulties with reading comprehension are usually due both to weak capacity of working memory and to small information stores. The combined result is that a developmentally disabled person has difficulties with making conclusions, as required by reading. Reading comprehension with developmentally disabled people can be facilitated by the use of short phrases and simple sentence constructions and by semantically “dismantled” text.

The normal aging process weakens the functioning of working memory in particular. If the aging is accompanied with dementia, memory traces may also disappear from long-term memory as a result of the condition. With a normally aging person, information has been compiled in the long-term memory over the person's whole lifetime, which helps reading comprehension and compensates for memory loss. When the working memory functions ineffectively and the long-term memory grows thinner at the same time, reading skills and reading comprehension can deteriorate fast. With aging people reading can especially be facilitated by short expressions, which reduces the burden on the working memory.

One major problem with reading comprehension among learners of the Finnish language is thinness of information in long-term memory concerning the studied language. It is not just a question of lacking
vocabulary or difficulties with managing the language structure, but also of narrowness of the cultural knowledge contained in language, i.e. pragmatic problems. If the capacity of the working memory is weak, the problems pile up. Reading can be made easier for learners of the Finnish language by the use of frequent vocabulary and transparent sentence structures. The length of the sentences and expressions is not as significant as it is, for example, with aging or developmentally disabled people, but especially at the start of learning the language, the burden on the working memory can be reduced by using short expressions.

**Plain language as a tool for working memory**

Memory-related reading difficulties can most effectively be eradicated by paying attention to the quality of the learning material on the one hand and to effectiveness of the reader’s own processing of information on the other. If the capacity of the working memory is weak, learning can be considerably improved by selecting material that places less burden on the working memory. Plain language is one of the most expedient tools that reduce the burden on the linguistic working memory. Clear, well parsed and structurally short language facilitates the functioning of the working memory. It reduces the burden of the new information (short sentences and familiar vocabulary) and makes it easier for a person to link new information into old (logicality and clearness of text references). Activation of processing during reading (i.e. deep processing) is also a good means to improve reading comprehension and the organization of new information in a manner optimal to reading. One of the key issues here is to activate the participation of the long-term memory during a reading event. Many studies in the field have expressed doubts about the possibilities to rehabilitate working memory. The functioning of memory is abstract and closely connected with steering of activity. Development of memory requires abstract thinking and an ability to steer one's own psychological processes.