WORKING MEMORY

WHERE DID I PUT MY GLASSES?

There are MANY different types of memory. There's remembering who the prime minister is, remembering someone's name you met earlier at a party, remembering a list of items to grab from the shop or remembering where you left your glasses. There's remembering how to make brownies without looking at the recipe, there's remembering the fun time you had at the snow last year and there's remembering your pin number. There's remembering the punch-line of a joke.

Working memory, however, is none of these.
Many children I have worked with over the years have had obvious and quite significant problems with their working memory. This is bound to affect how they can function and learn in the classroom and is an important factor to consider when a child is presenting with language, attention or learning problems.
For speech pathologists or educators working with these children, it is vital to understand about the different types of memory because if we want to help these children, we need to share with others exactly what we are talking about.
Many times when I have raised with a parent about their child's possible working memory problems, I've been met with comments such as; "No! He has a *fantastic* memory. He can recite EVERY WORD of SpongeBob SquarePants and he NEVER forgets when I've told him we're going to get chips after school.
These examples of *memory* are NOT examples of **working memory**.

SO WHAT IS WORKING MEMORY?

Working memory is the type of memory that is used when we hold on to information for a short time in order for it to be used. It can involve verbal information (words or sounds that are HEARD) or visuo-spatial information (information that is delivered visually). It also involves an element that controls and coordinates this information. This is called the "central executive."

Examples of working memory may include adding three numbers in our head that have been said to us, reading and then carrying out a list of instructions, silently repeating back an unfamiliar word as we attempt to spell it, copying homework instructions from the board into a workbook.

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Working memory is different to short term memory in that it requires some **mental manipulation of the information that is briefly stored**.
Gathercole and Alloway (2008) explain that working memory is a "system of linked components consisting of short-term memory stores of verbal (language) and visual or spatial information, and a coordinating component that controls attention called the central executive." This central executive gets the brain ready to remember and then coordinates the manipulation of the information stored in the short term memory so that the information can be used purposefully.

It is important to understand that working memory is not about information that was received earlier that day, nor is it remembering what a story was about when a passage has been read to us. Difficulties with working memory, however, may affect how a child can complete such tasks. If you have a lousy working memory, you may not have processed the information presented earlier that morning, or in the second example, you may have not been able to process and comprehend each sentence as it was read during the story. Although the problem here is working memory, it can end up looking like a different type of memory problem.

Working memory problems can be the root of many learning and language challenges in school.

HOW MUCH CAN BE STORED IN SHORT TERM AND WORKING MEMORY?

Miller (1956) came up with what he called the "magical number seven." He proposed that the average adult could hold on to roughly seven units of information in their short term memory, where each "unit of information" was defined as a distinct and unrelated item.

An example: If I gave you seven numbers to remember, but the first four just happened to be those at the start of your phone number, your brain would quickly group these as a chunk. This chunk then becomes one unit. Therefore, you could probably go on to remember more than seven digits in this instance as the first four digits became one. (Remembering "chunks" is actually a useful memory strategy which we will look at later in this article…)

In The Auditory Processing and Assessment Kit (APAK), Dr Kathy Rowe, Dr Ken Rowe and Jan Pollard state that at school entry, the average digit span of a child is 4 digits. That is, they should be able to repeat back four numbers when they are presented roughly one second apart. They propose that the 7% that cannot recall 3 digits are at great risk for literacy underachievement and from my experience, not only this is true, but these children usually have trouble concentrating in class, following instructions and learning new information that is presented verbally.

Working memory, however, is more complex than short term memory. In a recent lecture by Dr. Jarrad Lum, Senior Psychology Lecturer at Deakin University, he stated that that short

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term memory tests are not so good at predicting school achievement. He commented that often the children with poor short term memory would "catch up" whereas the children with poor *working memory* were the ones that really struggled.

One test of (verbal) working memory employed by many speech pathologists is the "Number Repetition – Backwards" subtest of the Clinical Evaluations of Language Fundamentals – Fourth Edition. (CELF 4). In this test, digits are said by the examiner and the child is required to repeat them back in reverse. For example, it starts with the examiner

saying "2…4" and the child is required to say "4…2" . Often you can almost see a child's brain working when they are doing this. They will usually say the numbers forward (rehearsal) before saying them in reverse. The next stage of the test goes to three digits "3…6…8" and the child again, must say them in reverse; "8…6…3". It continues from there. Some children fail this because they cannot hold on to the three digits even in their short term memory. When this is the case, they have little hope of manipulating the numbers and saying them in reverse. Some young children fail this because they don't understand the instructions. For example, some children don't understand what "*backwards"* means in relation to a string of numbers.
It should also be noted that this test is not performed well at the age of school entry by most children. In fact, according to the CELF-4 scoring, it is not until the age of six that an inability to repeat two digits back to the examiner in reverse order indicates that there may be a problem in working memory.
Backwards digit span is a good test to do with children from around the age of 8 years. By this age, most children are able to repeat back two numbers in reverse and are beginning to repeat back three. If they are unable to do so, it may be that working memory problems are at play, and could even be the root of language or learning problems.

WHAT AFFECTS WORKING MEMORY CAPACITY?

- Stress. Don't panic if you just had someone test you and you couldn't repeat back three digits in reverse. You were probably stressed! Yes, stress is one of the factors that can affect how much we can hold on to in the short term. Fatigue can also affect our capacity.
- Distractions (for example, background noise) can affect attention and therefore working memory.
- Alcohol and some medication.
- Familiarity. If information is more familiar, it is more easily held in the short term.
- Age. Working memory increases with age and by adolescence most individuals have reached their optimal level. Unfortunately, it decreases as we get older.
- Multi-modality. If we think of working memory as a "system of linked components", it holds that if the information is delivered using two modalities, we will remember it more easily. For example, if I said the names of numbers while showing you a list visually, you may be able to recall more numbers.
- Rehearsal is an important part of verbal working memory and children around seven years of age will start to use this as a strategy to keep information fresh in the verbal

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short term memory as they "work on it". The easier the verbal information is to repeat, the more easily it can be rehearsed and kept in the short term memory. Thus, a tricky sentence structure will be harder to rehearse and act upon, than a more straight forward one.

- Individual strengths and weaknesses. Some are simply blessed with great working memories, others are not so lucky…

THE CHILD WITH WORKING MEMORY PROBLEMS…

- Often has problems learning to read and write and with maths.
- Can be reserved in social situations that include a lot of verbal interaction.
- Finds it hard to follow instructions.
- May find it difficult to multi-task. For example, looking at the board and copying down sentences as the teacher explains about homework.
- May become overwhelmed easily which leads to stress. Stress leads to even greater problems remembering. Instructions they could follow yesterday may be too difficult to comprehend today. This inconsistency can be puzzling and frustrating for teachers.
- When overloaded, may "switch off" or play up in class.
- May spend a lot of their time being confused, but sometimes may be totally unaware that they have misunderstood.
- May find it extremely difficult to focus on a task that taxes their memory while there are distractions. Distractions might be a noisy class next door or the view of children playing sports outside.

SPECIFIC CONDITIONS AND WORKING MEMORY

Middle Ear Problems (including children with Down Syndrome)
Short term memory of verbal information can be reduced in children who have had, in their younger years, repeated bouts of "serous otitis media" (fluid in the middle ear) or ear infections. This is thought to be because they have not had the experience of hearing to "build up" and "practise" using their verbal short term memory store.
Children with Down Syndrome are at particular risk due to high incidence of middle ear pathology. (Downs and Balkany, 1988).

Dyslexia
Children with dyslexia tend to have poor verbal working memory. They often have trouble repeating complex multisyllabic words. For older students, an unfamiliar word such as "refractory" may be difficult for them to even repeat and thus spell. A child without dyslexia, may not know this word, may not have heard it, but can hold it in their short term memory, repeat it, break it up and attempt to spell it.

Reading can be viewed in a similar light. For a dyslexic child who tries to sound out an unknown word, they must try and "hold on to" and then "blend" sounds or familiar chunks.

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This can be exceedingly difficult. For example, "/sp/…/oi/… /l/…/t/..." Other children can sound out and "pull" these chunks together with ease, making a meaningful word.
Some researchers propose that working memory is not a symptom of dyslexia but a result of it. Because the process of reading is so difficult for these children, they do it less and their working memory suffers. Good readers, on the other hand, are constantly increasing their familiarity with words and their blending skills through reading, and thus actively strengthening their working memory.
Nevertheless, there does seem to be a subgroup of poor readers who have poor short term memory problems that contribute to their reading difficulties (Snowling, 1991).

Developmental Language Disorder (DLD)

Children with DLD often have difficulty repeating unfamiliar, multisyllabic non-words (e.g., *paglinot*), reflecting reduced verbal working memory. This impacts their ability to hold onto new sound patterns long enough to learn and store new words in long-term memory.

ADHD

Children with ADHD often experience difficulties with both verbal and visuospatial working memory. Differences in attention and inhibition can further impact their ability to hold onto and use information in the moment.

Autism

Autistic individuals show a wide range of working memory profiles. Some may have reduced verbal working memory, which can impact language processing, while others may have average or strong abilities in this area.

A FINAL NOTE:

In summary, it is important to consider a child's working memory abilities when assessing them for a possible language or learning impairment. Remember that sometimes working memory problems may present as disruptive behaviour, comprehension problems or long term memory problems.
Over the next three pages, you will find some strategies that can be printed off for parents or teachers. The strategies relate mainly to difficulties with VERBAL SHORT TERM MEMORY AND VERBAL WORKING MEMORY. Employing these strategies can make a world of difference for the child with reduced working memory.

This article was written by Lucia Smith in July 2012 and updated in 2026.

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WORKING MEMORY Practical Strategies for Home and School

What is working memory?

Working memory is the ability to hold onto information for a short time and use it. It is essential for following instructions, learning new information, reading, writing and completing everyday tasks. When working memory is reduced, children may appear inattentive, confused, or forgetful.

Ways to Help:

1. Use familiar language

Use words the child already knows. If introducing new vocabulary, repeat and explain the meaning.

2. Chunk information

Break longer instructions into smaller parts with pauses.

Instead of: *"Put your bag away and get your book and sit on the mat."*

Try: *"Put your bag away…(pause) Get your book…(pause)…And sit on the mat."*

3. Simplify sentence structure

Avoid complex sentence constructions.

Instead of: "You're not allowed to play on the grass oval unless a teacher-on-duty is present."

Try: "If you see a teacher-on-duty, you can play on the grass oval. No teacher, no play."

Interestingly difficult sentences are often delivered during times of discipline. These are times when the stress level of the child is UP and their working memory capacity is DOWN. Remember this.

4. Repeat key information

Repetition helps children hold onto information long enough to process it

5. Use clear, paced speech

Speak clearly, not too fast and with pauses between key ideas.

6. Stress important words

Highlight the most important parts of the message. Example: "Wait at the CORNER near the SHOP"

7. Ask the child to repeat back

Check understanding and support memory. "What are you going to do?"

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8. Use visuals and external supports

Support memory with visual cues and tools:

- Gestures – try and gesture key words
- Drawings or written notes
- Touch objects
- Checklists

Technology can also help:

- Notes apps or checklists
- Visual schedule apps
- Voice recordings of instructions
- Text reminders

9. Teach memory strategies (from ~7 years)

Help children understand how memory works and teach strategies such as:

- Internal rehearsal (repeating information inside one's head)
- Visualising (creating a mental image)
- Using external supports (writing, lists, reminders)

Encourage independence with:

- Reminder apps or alarms
- Digital checklists
- Recording and replaying instruction

10. Acknowledge effort and frustration

Working memory difficulties are real and can be tiring. Help individuals understand the nature of their difficulties.

Offer support, encouragement, and patience. Remember that reading, listening to the teacher and even engaging socially may take a lot more effort for the child with working memory problems. Stay positive and be creative in how you keep the child engaged and motivated.

11. Build long-term knowledge

Strong knowledge reduces the load on working memory. For example: Knowing sound patterns (e.g., blends such as br, cl etc.) helps children read and spell more easily without holding every sound in memory.

12. Show, don't just tell

Demonstrate tasks whenever possible. Then have the child explain or show it back. Pairing the speech with the action taps into two modalities which can help.

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13. Reduce distractions and stress

Minimise noise, clutter, and visual distractions where possible. Try and remove any pressures put on the child.

14. Adapt materials and tasks

- Use a reading window or ruler
- Number steps instead of using bullet points
- Cover completed work to reduce overload

Technology options:

- Take a photo of the board instead of copying
- Use digital worksheets
- Use tools such as Notability, GoodNotes or OneNote
- Use text-to-speech where appropriate

15. Provide low-demand time

Ensure the child has time to engage in activities that do not heavily rely on memory, especially when tired or overwhelmed.

16. Practise memory with games

Simple games can build memory skills:

- "I went shopping and I bought…" (Take turns and build on what the other person has said).
- "I went to the farm and I saw…"
- "I had a midnight feast and I ate…"

17. Allow replay and review

Listening once may not be enough. Support access to information by:

- Recording instructions (phone or tablet)
- Providing written or digital instructions

In summary,

- Reduce the load on the memory store.
- Repetition and chunking are two strategies that should be used by all.
- From seven years of age, teach the child how to use strategies that will help.
- Endeavour to build up the child's long-term memory store of knowledge and language.
- Consider other factors that reduce memory capacity (such as stress) and if possible, address these.

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