



Understanding Memory Difficulties



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It is important to clarify what is meant by various terms used to describe memory as some misunderstandings arise when we apply our everyday understanding to terms that have more precise meaning when used in psychological research. The most notable term requiring clarification is 'short term memory'. When difficulties in short term memory are referred to in relation to difficulties in dyslexia and literacy development psychologists are referring to difficulties in short term memory within the working memory model and not our everyday understanding of difficulties in remembering in the short term. This should be remembered when reading various documents, articles and publications which refer to short term memory difficulties.

What is working memory?

Working memory refers to the retention of information in short term (temporary) storage while processing incoming information and retrieving information from long term storage. Short term storage within this working memory model refers to holding information in memory for 'seconds' before it fades away or is discarded and the average adult cannot hold more than six or seven units of information in short term memory. According to Gathercole and Alloway (2008) if a child is distracted or interrupted while using working memory the process is lost and the child cannot resume from where they were interrupted. The child must start the task from the beginning again. They also point out that a teacher can expect, in a class of seven year olds, a six year range in working memory capacity. In a class of 30 seven year olds, 3 children will have the working memory capacity of a 4 year old and three children will have the working memory capacity of a 10 year old. These differences have a significant impact on learning and the ability to cope with various strategies currently in vogue to promote learning. According to Gathercole and Alloway (2008) children with high working memory scores typically show excellent reading skills at all ages and also do very well on tests of mathematical ability. Conversely, children with relatively poor working memory scores tend to perform below average levels on these attainment measures.

What is meant by short term memory when used by psychologists?

'Short term memory' simply refers to the storage of information (for a matter of seconds) without having to manipulate it in any way. If we have to manipulate what we are holding in short term memory to complete a task or whilst doing something else at the same time, we are using working memory. This distinction is very important.

What is short term memory in relation to our everyday understanding of the term?

The more common every day understanding of remembering in the short term is therefore quite different from the more precise definition used by psychologists when referring to short term memory within the working memory model. When using our everyday understanding of short term memory we may be referring to something that can't be remembered after half an hour or half a day or two days later. This is a concept that many parents can relate to ... that their child forgets some things easily and may require opportunities for 'over learning' so that something that is remembered in the short term becomes a permanent memory. Some children will need a lot of repetition at regular intervals before something is transferred to the long term memory store. Other children will need much less in terms of repetition and rehearsal. However, more than just repetition and rehearsal is necessary for efficient storage in long term memory and whilst rehearsal aids storage of material (for example, remembering a telephone number) it disrupts working memory.

What is long term memory?

Long term memory refers to the permanent storage of knowledge in memory stores located in various parts of the brain. It should be remembered that retrieval from long term memory is aided by meaning. Unless meaning is attached to new learning retrieval will be difficult if not impossible e.g. children who learn sounds in isolation very often forget them very easily because they have no associated meaning.

Pattern is also very important in reducing the demand of limited capacity within long term memory stores. Pattern is also important for efficient organization in memory, this will be discussed later.

What does this mean for learning and teaching?

Many children with learning difficulties have memory problems that make learning more difficult. It is very important that teachers are able to assess the memory demands in the strategies they are using. In some cases interventions that place demands on various aspects of memory can exacerbate rather than alleviate difficulties. As well as assessing a child's difficulties in learning it is essential that teachers assess the memory demands of the strategies they are using.

It is interesting to note that research conducted by Everett, Weeks, and Brooks (2008) found that compared to controls children with dyslexia, specific language impairment and moderate learning difficulties showed significantly poorer performance on:

- Phonological awareness
- Rapid naming
- Verbal span

The performance of children with Dyspraxia, EBD and ADD was not significantly different to controls suggesting that an alternative causal pathway(s) may be needed to explain their poor literacy scores.

What is verbal span?

Verbal span is one of the measures used when assessing short term and working memory difficulties. For example, asking a child to repeat a simple sequence such as 2, 5, 8 utilises short term memory whereas presenting the child with a simple sequence e.g. 2, 5, 8 and then asking him/her to repeat it backwards

involves working memory. The latter is a working memory task because the child has to hold the digits 2, 5, 8 in short term verbal memory whilst he/she works out how to repeat it backwards.

Gathercole and Alloway (2008:35) point out that working memory ability rather than short term memory is a better predictor of achievement in areas such as reading.

Principles of working memory intervention

Gathercole, S. and Alloway, T (2008: 70-90) suggest the following key principals of working memory intervention. Some examples are provided for clarification where necessary.

Recognise working memory failures

1. Incomplete recall
2. Failure to follow instructions
3. Place keeping errors
4. Task abandonment

Monitor the child

1. Look out for the warning signs of working memory overload (see above)
2. Ask the child directly what he/she is doing

Evaluate the work demands of learning activities

1. Excessive length (under 10s with working memory difficulties struggle to hold in short term storage 3 or more items)

2. Content that is unfamiliar and not meaningful places considerable burden on working memory
3. A demanding mental processing activity (memory load plus processing a task e.g. identifying and blending individual sounds in words where there are more than two phonemes is a demanding mental processing activity for children who have difficulties in working memory)

Reduce working memory loads

1. Reduce the amount of material (e.g. use shorter sentences. Give instructions with accompanying actions to make the content of the instructions easier to remember.)
2. Increase the meaningfulness and familiarity of the material (ensure use of pattern and meaningful associations)
3. Simplify the mental processing (e.g. simplify the grammatical structure of sentences. Ensure children recognise larger units of sound for decoding and encoding, e.g. initial blends and rhymes. Initial blends and rhymes can reduce working memory demands substantially. The working memory demands in one syllable words can be reduced to two units by using 'onset and rime'.)
4. Restructure complex tasks (break down tasks into independent steps)

Be prepared to repeat

Employ strategies that tailor repetition to the needs of individual pupils. Not all children require repetition. Encourage children with WM difficulties to request repetition or partner a child with WM difficulties with a child with good memory skills.

Encourage the use of memory aids e.g. personal memory cards

- Writing aids (What is a sentence? poster / spelling aids)
- Mathematical aids (multiplication grids, number lines, fingers, memory cards)
- Audio devices
- Computer software

Develop the child's use of strategies for supporting memory

- Request help (select a person to ask)
- Rehearsal (of small amounts of verbal information)
- Note-taking (check notes regularly as task is being performed)
- Using long term memory (meaningful chunks as opposed to lengthy sequences)
- Place keeping and organisational strategies (diagrams, flow charts to depict task structure)

Examples of the impact of working memory difficulties

1. ORGANISATION

According to Gathercole and Alloway (2008) to be organised we must be able to carry round, in our heads, a list of what we have to do or what we need throughout the day. If these details quickly fade from memory then not being able to remember makes many everyday activities very difficult and stressful.

Many children with working memory difficulties present as being poorly organised.

They suggest that help with personal organisation should be given by providing:

- Daily timetables
- Lists of items needed for various activities or classes
- Diaries
- File dividers
- Schoolbags with sections to aid organisation of books and materials needed
- Consider when secondary pupils will return to lockers and help them organise what they will need and when they will return next.

2. ATTENTION

Gathercole and Alloway (2008) also stress the importance of recognising that children with limited working memory capacity can appear to be inattentive, asking their neighbour what the teacher has just said or interrupting. This may be the result of limited working memory capacity.

They suggest that teachers BE PATIENT:

- Keep instructions simple, avoid complex instructions. Give instructions one at a time.
- Allow extra time for thinking so that the child has time to process what has been said.
- Agree with the child a discrete way of knowing if more time is needed.
- Seat the child in a position that makes communication easier i.e. at the front of the class close to the teacher.
- Repeat key words or phrases.

3. WRITING

- The need for copying should be avoided, particularly from the board.
- Allow alternative methods of recording e.g. mind maps, diagrams, Dictaphone.
- Introduce joined handwriting as soon as possible as this reduces place finding and orientation difficulties. (McMurray, Drysdale and Jordan (2009) discuss the impact of motor processing difficulties on learning).

4. SPELLING

Dictation

Dictation sentences are a good method for practising and testing spellings. Hornsby ('Alpha to Omega') suggest the following approach to help with working memory difficulties.

- Dictate the whole sentence.
- Ask the child to repeat it.
- Dictate it again, saying each word very clearly.
- Child writes the sentence saying it clearly as he or she writes it.
- Child is asked to read aloud exactly what he or she has written.
- Final corrections are suggested if the student has failed to discover them.

Patterns and sequences

English is a deep orthography and once children pass the early stages of learning to spell (i.e. CVC, CCVC, CVCC) sound/ symbol mappings can be multiple in both directions.

The importance of teaching 'onset and rime' is well established. Synthetic phonics is a beginning strategy. Indeed Turner and Bodien (2007) advocate the use of synthetic phonics in reception classes (YR1 NI). However, children need to move on from this approach as Turner and Bodien stress. They draw on evidence from the case study of a 7 year old who failed to progress despite considerable phonics teaching.

'she was not segmenting words into their ONSET AND RIME. Consequently, each word appeared as a new item to her that she laboriously decoded phoneme by phoneme rather than decoding by ANALOGY for lists such as 'cat, fat, mat, sat, and hat' where just the first phoneme needed to be changed!'

Teachers will recognise children in their class who read in this laboured and pedantic way and must ensure that they move away from this overdependence on decoding at the phoneme level. If children cannot identify syllables as unified units and split the syllable at the onset and

rime level then they may experience memory and retrieval difficulties which manifest in dysfluent reading and phonetically plausible spelling errors. If these spelling errors are repeated and written several times they may become embedded in memory or continued dependence on encoding by sound may result in long term spelling difficulties. Teachers will also recognise children in their class who are good readers and poor spellers. This group of children do not know whether a spelling looks right. Their difficulties in spelling confound teachers because they fail to understand why children misspell words that they can read. Unfortunately some children experience difficulties in spelling long after reading difficulties are remediated and these spelling difficulties can become lifelong (Trieman 1997, Frith 1980).

Recommendations

1. Ensure spellings are consistent in the sounds they make and visual spelling pattern. For example consider the three groups of spellings below:-
 1. 'red, bed, fed, led'
 2. 'bread, head, lead'
 3. 'said'

Lists 1, 2 and 3 above should be treated as three separate groups even though they have the same rhyming sound. They should not be taught together. Even though the word 'said' appears frequently in reading books children with literacy difficulties often revert to a phoneme encoding strategy and draw on the individual phonemes that come to memory most easily for them. If children attempt to spell words by phonemes alone then the word 'said' could be spelled 'sed' and many teachers would recognise this as a common misspelling. Correct spelling retrieval is governed by meaning (consider 'their' and 'there') and visual recognition that a spelling looks right. The knowledge of

whether a spelling looks right can only be achieved if the child has representations in memory of the correct pattern to which the word belongs.

Patterns and sequences which are consistent in sound and spelling are essential for the development of long term memory and short term processing within working memory. The mental lexicon (visual memory for whole words and letter patterns) is limited in capacity and children must recognise that if they can spell one word in a pattern they can spell many more words that belong to that pattern. If I can spell 'red' I can spell 'bed' by changing the initial sound (phoneme). Reasoning by analogy reduces the load on working memory.

2. Discourage children from spelling by sound alone once they pass the simple CVC stage. Spelling by sound without regard for orthographic knowledge (i.e. knowledge of whole words and 'onset and rime' patterns) results in phonemic spelling errors such as 'becos' for 'because'. Examples of other phonemic spelling errors are 'helpt' for 'helped', dancd for danced, landid for landed. It is important to draw on spelling rules (morphological knowledge) to overcome this type of spelling error e.g. adding 'ed' to regular verbs to make the past tense.
3. Never group words visually without regard to sound e.g. 'prove, glove, stove' children with dyslexia find these groupings confusing as they are not consistent in the sound they make.
4. Trieman (1997) and Frith (1980) both point out that children with spelling difficulties cannot reliably choose from a range of plausible alternatives and their spelling errors are consistently phonetic. Avoid grouping spellings that have same sound, different spelling e.g. vowel phonemes as in 'though, go, toe, show, note, boat'. These groupings are very confusing for children with poor orthographic processing.
5. Irregular words should be learned using multisensory techniques e.g. Look, say, cover, write, check; tracing on sandpaper and in the air;

spelling words using wooden or magnetic letters; writing in joined handwriting.

6. Irregular high frequency words should be taught in semantic groupings in the early stages of spelling development.

5. LEARNING LETTER NAMES AND LETTER SOUNDS

Turner and Bodien (2007) suggest that young children need to learn both their letter names and their letter sounds. Indeed, it is only a very small proportion of children who experience difficulty learning the names of the letters of the alphabet. Teaching letter names is important teaching at a whole class level. Carroll et al (2003) point out that there is an important reciprocal relationship between letter knowledge and phonemic awareness. For the small group of children who do experience difficulty Turner and Bodien (2007) suggest learning the letter names with the aid of wooden letters ('The alphabet arc' is well established as a successful method for doing this). They suggest that letter sounds should be taught when working with flashcards or magnetic letters.

'keeping the use of letter sounds and names apart physically like that helps the children know which response to give to each medium.' P27

6. READING COMPREHENSION

The goal of reading is comprehension and this is greatly affected by limitations in working memory capacity.

Gathercole and Alloway (2008: 54) explain the demands of the task required

'by holding the words that have been recognised from print for a sufficient period of time to enable the reader to link the words together to produce a meaningful interpretation of the clause or sentence, or even larger sections of text'

If this process is further compounded by the need to decode then reading comprehension becomes an impossible task. The dyslexic reader has to

interrogate the text many times to extract meaning. Children with dyslexia are recognised to have problems in the 'unitization' of sounds. Unitization (Bresnitz, 2006) is the ability to process increasingly larger units from letters to spelling patterns to whole words and connect them to phonological and semantic codes in memory. If children have to decode unknown words, taking each sound in turn, then the working memory demands of decoding may make the unitization of the sounds impossible. Children with working memory difficulties find blending sounds very difficult. When you add the demands of decoding to the working memory demands of reading each word in a sentence the difficulties in reading comprehension experienced by some children are clear.

Warning signs (Turner and Bodien, 2007 pg 75)

- Decoding is so laboured that it consumes WORKING MEMORY capacity. As a result, a pupil can decode a sentence without having processed the meaning of the sentence.
- Punctuation is ignored.
- Inferences are missed.
- The pupil believes that decoding is the end goal of the reading process.
- The pupil does not 'engage' with the text.
- Key sentences and key words are not identified and attended to.

Suggestions

- Use cloze passages
- Sentence completion exercises
- Paragraph analysis

Carry out paragraph analysis (sentence order, inferences, the way each sentence builds up detail cumulatively)

- Use key words highlighting the main ideas and how they link and make a diagram.
- Identify key words relating to inferences and link to the main key words.
- Use the diagram as a prompt to guide the child when writing the paragraph in sentences using his or her own words.

Conclusion

The aim of this paper has been to introduce teachers to memory difficulties, in particular working memory difficulties, and how they impact on learning. It is hoped that class teachers will begin to identify memory difficulties and make appropriate modifications to strategies they are using. When planning learning activities for children in their class teachers should ensure that support for children with memory difficulties is included in their differentiated approach.

C=consonant, V=vowel (CVC = consonant, vowel, consonant e.g. map; CCVC = slap; CCCVC=strap)

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Recommended Reading

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