

Children with Down's syndrome – Information Sheet.

Short-term Auditory Memory

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Short-term auditory memory, (working memory) also called verbal memory, helps us to make sense of language. We use this memory to hold, process, understand and assimilate spoken language. It relates directly to the speed with which we can articulate words, and influences the speed at which children learn new words and learn to read.

How does short-term auditory memory work?

Many theories about memory suggest that words we hear are received and stored in our working memory in order to make sense of them. They are then transferred to a more long-term store. However, words are only retained in the working memory for two seconds unless consciously kept there by silently repeating them to oneself, called rehearsing. The amount of information we can retain within the two-second span is called the **auditory digit span**. One way of measuring this digit span is to see how many digits, said at the rate of one per second, a child can repeat back. Words or nonsense words as can also be used.

Is there a relationship between Down's syndrome and working memory?

Yes, many children with Down's syndrome have difficulties in this area. Generally, long-term memory is not impaired; neither is the visual memory, which is often far stronger.

Why do many children with Down's syndrome have poor working memory?

This is not clear, but it is probably due to a deficit in the store or an over-rapid decay rate. In addition, children with Down's syndrome do not seem to develop normal strategies, such as rehearsal and organisation or chunking skills, to help them remember information. A further reason is that the auditory digit span tends not to improve with age as it does for typically developing children. Prof. Buckley found that for teenagers with Down's syndrome, it often only reaches 3 or 4 digits as opposed to a typical span of 7. This means that there is an increasing difference between mental age and memory performance in children with Down's syndrome.

What are the general implications of having poor working memory?

Working memory affects the ability to learn routines and develop organisational skills. In addition, because this memory plays an important role in developing language skills: in acquiring and retaining vocabulary (including phonic awareness and discrimination); in understanding and producing language (including grammar and spoken and written language), any deficit will greatly affect a pupil's ability to respond to the spoken word or learn from a situation relying heavily on auditory skills.

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Critically, words disappear too quickly from memory. A child struggling to process and remember what was said can quickly become overloaded if given unfamiliar vocabulary or long, complicated sentences. The child will either switch off completely or retain only parts, often from either the beginning or end of a sentence. This poses real problems for children in school situations with a high auditory content, such as:

Carpet time

Listening to a new story

Whole class discussions

Hearing unfamiliar subject-specific vocabulary

Circle time

Assembly

Being given instructions

Mental maths

A child may have difficulties in:

- Processing and storing information, especially when processing speech alone
- Phonological awareness: learning letters and letter sounds
- Differentiating speech from environmental sounds: auditory discrimination
- Remembering things that they hear: auditory memory
- Learning new vocabulary: poor learning of colours is typical
- Remembering unfamiliar or abstract vocabulary
- Remembering sequences or lists: these fade quickly if not rehearsed and used regularly
- Understanding information they hear: auditory perception
- Following long verbal instructions
- Forming longer words and phrases
- Developing reading, comprehension and grammar

How can we help improve working memory?

By adopting appropriate differentiation and teaching strategies which do not **rely** on this memory alone. Several approaches and media are needed in order to tap into other memories and store information in different ways. Teaching mainly through language fails to maximise learning, particularly when teaching physical or practical skills. In addition, rehearsal-based training programmes may lead to improved short-term auditory memory. **However, the main method of reinforcing verbal information for children with Down's syndrome is visual.**

How do I help develop general memory skills?

- *Reduce distractions, keep activities short and give plenty of short breaks.*
- **Play games** which develop visual strategies to aid memory e.g:
 - *Barrier games, where a small screen is set up between the child and a partner. The partner gives the child a short instruction with no visual clues. The child has to carry out the instruction e.g. arrange some bricks in a particular order.*
 - *Memory games: e.g. Kim's games, Pairs/Pelmanism.*
 - *Listening games: e.g. Sound Lotto, Simon Says, Guess Who, Twenty Questions.*
- *Make use of songs, rhymes and rhythm.*

Make learning visual:

- *Accompany key words and checklists with pictures, icons, and symbols.*
- *Develop your own diagrams or icons for keywords and subject-specific words.*
- *Use keywords, icons and diagrams rather than full text.*
- *Underline and highlight keywords.*
- *Make use of word trees, maps or webs.*

New Learning

- *Make use of the procedural memory by role-play, drama, and physical movement.*
- *Provide plenty of practice when teaching **routines**, key procedures and sequences.*
- *Make use of routines to help learning.*
- **Association** – *help child link information with a more familiar word, picture, idea or image.*
- *Provide regular over-learning opportunities to recall information, even after you think the child has learned it.*

Language

- *Help the child to be aware when they have to listen e.g. pointing to your ears.*
- *Limit amount of verbal instruction at any one time – **Chunk** into smaller, simple phrases.*
- *Encourage child to chunk and categorise information –categories may need to be taught.*
- *Repeat individually any information or instructions given to the whole class.*
- *Pause, Repeat, Check - ask child to repeat back or clarify.*
- **Rehearsal** –*help child achieve silent rehearsal by whispering information to themselves more and more softly until they can do it silently.*
- *Encourage child to take daily messages.*
- *Avoid giving auditory stimuli that are very similar.*
- *Teach and develop **reading**. Reading is a visual tool that reinforces and develops language skills. [Note: using phonetic strategies is problematic: the ability to remember letter names, sounds and phonic rules all rely on good memory. Children with Down's syndrome are, though, often able to develop a sight vocabulary by relying upon stronger visual skills.]*
- *Allow extra time and encourage child to re-read information.*
- *Assess comprehension on short pieces of text (e.g. page by page) and through visual means e.g. written worksheets with cloze procedure for answers.*
- *Teach grammar specifically through meaningful contexts and in practical situations.*
- *Teach grammar visually. Use pictures, concrete objects, Rebus symbols, signs or gestures and the written word.*

For sequences and lists

- *Provide visual reinforcement, regular repetition and rehearsal.*
- *Music, rhythm and song can help when learning sequences (e.g. the alphabet, times tables, days of the week) as well as for teaching phonological awareness/skills and sound patterns. The tune alone can trigger the speech sequence for the child.*

Writing and Spelling.

Writing a sentence is a highly complex task. For many pupils with Down's syndrome, being able to form a correct sentence is in itself a major step. Difficulties with working memory make writing a sentence down even more complex as the child has to remember the sequence as well as letters, sounds, and spellings. Taking notes and dictation are particular problem areas.

Spelling can be very difficult as it involves recall and auditory discrimination of many different sounds and letter-sound rules. Many children can be taught to use basic phonic strategies given clear and explicit teaching, but most will be spelling words purely from visual memory.

How do I improve writing skills?

- **Reading, speaking and listening all help and support writing skills so it is extremely important to do these prior to any written task.**
- *Teach phonic/alphabetic strategies explicitly.*
- *Help child link letter sounds with names through a connection. e.g. symbol, 'Letter Land'.*
- *Colour code similar letter groups or patterns within words.*
- *Cued articulation. The child links a physical prompt or sign with a particular sound: the movement triggers the awareness and articulation of the sound.*
- *Accentuate link between speaking and writing: child to say/read aloud before writing down.*
- *Provide visual clues such as pictures, word banks, storyboards (drawing a series of scenes for a story), writing frames, picture sequences, cloze procedure, word/picture dictionaries.*
- *Ask pupil to write only familiar sentences and events first.*
- *Encourage child to listen to tapes for re-telling. Stop and start the tape in small chunks, then help the child to re-tell and write the chunk they listened to.*
- *For spelling, use visual and multi-sensory methods, e.g. flash cards, finger tracing and Look - Say - Cover - Write - Check method.*

Numeracy skills

Many difficulties are due to problems with storing or keeping track of numbers and sequences while further processing is carried out. Mental maths and times tables can be particularly hard.

How do I improve Numeracy skills?

- *Reinforce numbers visually: number lines, number cards, 100 squares etc.*
- *Use concrete materials as much as possible.*
- *Teach child to associate numerals with particular visual images or colours.*
- *Use visually based mathematical schemes and equipment e.g. Numicon and Cuisenaire rods.*

Acknowledgements

Professor S. Buckley.

This information sheet cannot do full justice to the topic of short-term auditory memory and children with Down's syndrome. Professor Sue Buckley, Gillian Bird & Irene Broadley, in collaboration with Chris Jarrold, University of Bristol, have done much work in the area. For more in-depth treatment, please refer to the Further Reading section below and the Down syndrome Educational Trust, (DownsEd), Portsmouth.

Further Useful Reading

Baddeley, A.D. (1986). *Working memory*. Oxford: OUP

Baddeley, A. D. & Hitch, G. J. (1974). *Working memory*. In G. Bower (Ed). *The psychology of learning and motivation* (pp 47-89). New York: Academic Press.

Broadley, I. & MacDonald J. (1993) *Teaching short-term memory skills to children with Down's syndrome*. Down's syndrome: Research and Practice vol.1.2

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Jarrold, C. Baddeley, A.D. Phillips, C. (1999) Down syndrome and the Phonological Loop: The Evidence for, and Importance of, a Specific Verbal Short Term Memory Deficit. *Down Syndrome Research and Practice*, 6.1.

Thornton D. (1999) *Remember, remember*. *Nursery World* April 1999.

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