

DOWN SYNDROME FOUNDATION
OF ORANGE COUNTY

Why All The Fuss About Short Term & Working Memory?

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Introductions and Information

Me

- Dana Halle
- Co-Founder/Executive Director of DSF
- Lawyer/Developer of The Learning Program™
- Mom to Lauren, Patrick and Nicholas

You

- Parents – ages of children?
- Teachers – grades? Therapists?
- Currently work on memory?


Info

- Questions welcome within reason
- Available after session
- LP Email Group

Take-Away Points:

- Basic understanding of STM and working memory
- Research relative to children with Down syndrome
- Activities to build & support memory
- Classroom interventions
- Resources


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Why Talk About Short Term & Working Memory?

- Area of recent interest, attention and research
- Provides understanding of some learning challenges faced by students with Down syndrome
 - Link between WM and learning
- Guides us towards interventions that may improve our children's ability to learn and to process the world around them


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What Is Working Memory?

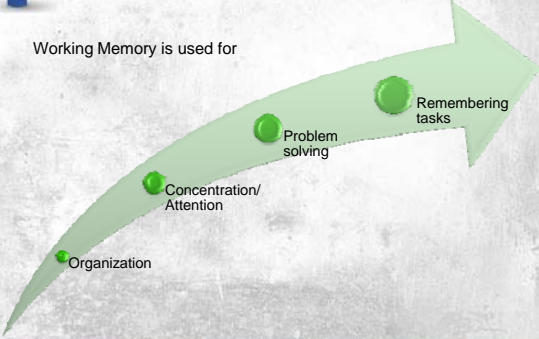
- The ability to keep information in your mind for a short period of time – seconds - and be able to use the information in your thinking
- A system for **temporary storage** and **manipulation** of information necessary for a wide range of cognitive tasks
 - mental workspace or search engine of the brain*

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Working Memory Impacts Daily Life

Working Memory is used for



- Organization
- Concentration/Attention
- Problem solving
- Remembering tasks

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Working Memory Impacts Learning

Age	Working memory needed
Pre-school	<ul style="list-style-type: none"> Learning the alphabet Learning to talk Focusing on short instructions like "come brush your teeth" Remaining seated to complete independent activities (puzzle) Listening to and following directions

www.cogmed.org

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Working Memory Impacts Learning

Age	Working memory needed
Elementary School	<ul style="list-style-type: none"> Reading and understanding the content (comprehension) Mental arithmetic Writing while formulating next part of sentence Interacting and responding appropriately in peer activities (group projects/recess)

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Working Memory Impacts Learning

Age	Working memory needed
Middle School	<ul style="list-style-type: none"> Doing homework independently Planning and packing for an activity Solving multi-step math problems Participating in team sports

Adults: getting to work on time, prioritizing activities, handling conflict

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Working vs. Long-term Memory

- Different systems
- Long-term memory stores information for hours to a lifetime
- Types of long-term memory include:
 - **Episodic** - details of experiences, events & life (what you ate for breakfast or wore yesterday)
 - **Autobiographical** - basic personal facts and major lifetime periods (name, information about your family, schools attended)
 - **Semantic** - stored knowledge about world, things you simply know or learned long ago
 - **Procedural** - actions or skills learned through practice that become automatic (walking, riding a bike, whistling, driving a car)
- **IMPORTANCE:** Can use long-term memory to supplement weak working memory

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Working Memory Model - System of Interlinked Components

Short-term Memory – Storage of information

Working Memory - Storage and manipulation of information

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graph TD
    CE((Central Executive)) --> VSTM((Visuo-spatial short-term memory))
    CE --> VSTTM((Verbal short-term memory))
    VSTM <--> VSTTM
          
```

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Working Memory Model - System of Interlinked Components

Verbal STM – stores any material with a verbal label – (words, sentences, numbers)

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graph TD
    CE((Central Executive)) --> VSTM((Visuo-spatial short-term memory))
    CE --> VSTTM((Verbal short-term memory))
    VSTM <--> VSTTM
          
```

☐ Presented verbally, visually or both

☐ Also called phonological loop

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Working Memory Model - System of Interlinked Components

Central Executive

Visuo-spatial short-term memory

Verbal short-term memory

Visuo-spatial STM – stores images, pictures, info re locations

□ Also stores shapes, orientations and patterns of movement.

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STEP 1: ASSEMBLE PART A TO PART B. STEP 2: GLUE THESE PIECES SECURELY. STEP 3: FIND PART C AND CONNECT TO PART D...

Jack Jones © 2002

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Working Memory Model - System of Interlinked Components

Central Executive

Visuo-spatial short-term memory

Verbal short-term memory

Central Executive – general component that directs attention and is involved in higher-level mental processes

Coordinates storage and effortful mental processing

□ No link between visuo-spatial and verbal STM – can't communicate directly

□ They store information in fundamentally different forms

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How Do You Measure It?

➤ Automated Working Memory Assessment (AWMA)

- Newer, simple and reliable measure of all significant elements of working memory, computer-based program

➤ Forward digit recall* (avg. 7 units)

- must store and accurately reproduce material in same order (measures verbal STM)

➤ Backward digit recall* (avg. 4-5 units)

- must store, reverse the order and recall (measures working memory because have to manipulate numbers)

*Limits to these types of assessment (number based and only relate to information stored in verbal short term memory)

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More Ways To Measure

➤ Picture, Word or Nonword recall

- similar to digit recall but using pictures, words or nonwords (measures verbal STM)
- can be presented verbally or visually

➤ Pattern recall

- recall order of presented pattern (measures visuo-spatial STM)

➤ Corsi blocks task

- must recall order in which blocks are marked or tapped (measures visuo-spatial STM)

➤ Reading Span

- listen to sentences – tell true/false and last word of sentence (measures working memory)


➤ Odd Man Out

- Which shape different and where was it on the page. (measures WM and VS STM)

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Crazy Slide – Measurement Overlap


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WM Development - Additional Facts

- Working memory capacity increases with age to about 15 years old
- Large variations between individuals
- Ability to pay attention and shut out distractions is important to WM
- Also important is ability to shift attention between activities

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What Does Research Show?

Specific impairment in auditory STM

It also shows that visuo-spatial STM is a relative strength

Means processing verbal information is more difficult


Makes learning from listening more difficult

Impacts vocabulary and sentence learning






Believed to explain some of the speech and language delay

Source: DSE International, Dsij - Memory Development for Individuals with Down syndrome


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Contributing Factors?

	Hearing loss and weak sound discrimination provides poor information to store	If can't hear – can't store
	Impairment in phonological loop - verbal storage function	If can't capture – can't recall
	Less vocabulary = harder to rehearse and recall	Harder if unfamiliar with info
	Slower retrieval from long-term memory or slower speech rater	May lose some recall because takes longer to rehearse
	Lack of rehearsal strategies	


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What Does WM Deficit Look Like?

Is easily distracted when working on or doing something that is not highly interesting.	Struggles with reading comprehension and has to read through texts repeatedly to understand.	Struggles with problem solving that require holding information in mind, for example mental math calculations.	Is inconsistent in remembering math facts.
Struggles with completing tasks, especially multiple step tasks.	Has difficulty remembering long instruction given in several steps (i.e., directions for school/work assignments).	Struggles to understand the context in a story or a conversation.	Has difficulties when planning and organizing something that needs to be done in separate steps.
Has difficulty staying focused during cognitively demanding tasks but attends well when cognitive demands are minimal.	Has difficulty integrating new information with prior knowledge.	When called on, forgets what he/she was planning to say.	Has difficulty taking notes and listening at the same time.

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What Can We Do At Home/School?

Interventions

- 1. Check hearing regularly
- 2. General literacy instruction
- 3. Targeted activities
- 4. Rehearsal training
- 5. Working memory support in classroom

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What Can We Do?

General Literacy Instruction

Reading, phonics & spelling = improve auditory discrimination – more accurate phonological representations

Practicing sentences helps improve memory for longer sentences

Reading aloud may help with clarity of spoken words and more accurate storage

Increasing vocabulary

Language rich and language demanding setting

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What Can We Do?

Targeted Tasks/Games

- Activities to improve sound discrimination and phonological awareness
- Activities to improve attention and increase processing capacity
- Activities to improve remembering of lists or numbers of items – called rehearsal training
- Memory games

[SEE COMPENDIUM FOR ACTIVITIES](#)

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What Can We Do?

Memory Training Tasks – Rehearsal Training

- Rehearsal training can improve STM
- Both visual and verbal memory spans can be improved
- Visual STM improvements greater than verbal
- Parents can be effective trainers
- Periodic maintenance necessary to make improvements last longer than months
- Remaining Questions – Can skills be generalized and transferred to other tasks? Do they translate into better academic performance?

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Memory Training: Visually Prompted STM Activities

Digit span tasks:

- You show
- Child says, signs (or shows)

Numbers	Pictures	Direction/Touch Sequences
3 5 1 7 2	dog bird clock	wave clap jump

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Single Object – Hide and Recall

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Single Object – Hide and Recall

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Single Object – Hide and Recall

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Visual Picture Task

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Visual Picture Task

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Visual Picture Task

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Visual Number Task

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Visual Digit Span

6 3 7 2

Build on current set or start fresh


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Visual Digit Span

6 3 7 2

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4 1 7 5

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4 1 7 5

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Visual Number Sequence



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Visual Picture Sequence



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**Memory Training:
Verbally Prompted STM Activities**

Digit span tasks:

- You say
- Child says, signs (or shows)

Numbers	Words	Nonwords	Direction/touch sequence
3 5 1 7 2	purple red blue	dag fob rik	wave clap jump



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Auditory word task with visual reinforcement


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 **Auditory Word Sequence** 




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 **Auditory Direction Sequence** 



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What Can We Do?

Classroom Interventions – 7 core principles

1. Recognize working memory failure
2. Monitor the student
3. Evaluate working memory loads
4. Reduce working memory loads when necessary
5. Repeat important information
6. Encourage use of memory aids
7. Develop student's own strategies to support memory

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Classroom Interventions – Teacher/Aide Focus

Reduce amount of information to process (simpler sentences, simpler work product)


Use visual notes (words and/or pictures) and actions (pointing and/or using hands) to help student understand lesson and lecture

Break tasks into sequence of independent steps (child can track progress and mark off completed steps)

Repeat information where necessary or have a classmate serve as "memory guide"

Use memory aids (proximity to student and practice at use important)

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Classroom Interventions – Teacher/Aide Focus

Position student in classroom to minimize distraction, background noise and within good hearing range of teacher

Use visual support for classroom rules and procedures where possible – such as lists of rules, written directions and daily schedule

Use front-loading (before) and rehearsal (after) to reinforce lesson

Use prompts when it is time to listen to verbal instruction


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Example of Verbal Alone vs. Verbal and Visual

Hear:
The dog chasing the tan cat was brown.

What color was the cat? Who was chasing the cat? What color was the dog?

Hear and see:



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Classroom Memory Aids

Writing – personalized dictionaries, flash cards, wall charts, word strips.


Math – number lines, multiplication tables, calculators

Computer programs with prompts

Classroom Intervention – Student Focus

Self-help strategies: request help, rehearse verbal information, take notes




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Self-help strategy?

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Memory Resources

The Centre for Working Memory and Learning
www.york.ac.uk/res/wml/index.html

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Memory Resources - Web

www.cogmed.net

www.random.org (random sequence generator)

www.lumosity.com (\$79.95/year)


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Memory Resources – iPad




iPad Apps

 Abby's Animals - Memory Game Education Released Aug 01, 2011 FREE	 Abby - Go Memory Education Released Aug 01, 2011 \$0.99 BUY	 Princess Pony - Matching Games Updated Mar 29, 2011 \$0.99 BUY
 Crazy Copy Games HD Entertainment Updated Dec 07, 2010 FREE	 Memory Puzzle Education Updated Apr 01, 2011 \$2.99 BUY	 Memory Matches Games Updated Aug 02, 2011 FREE


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Memory Resources – DVDs/Books/Games

- www.littlegiantsteps 
- www.linguisystems.com 
- DK Games: My First Picture Pairs or any matching game 
- See and Learn Memory – COMING SOON

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Take-Away Points:

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Questions or comments?



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