


Working Memory: The New Intelligence

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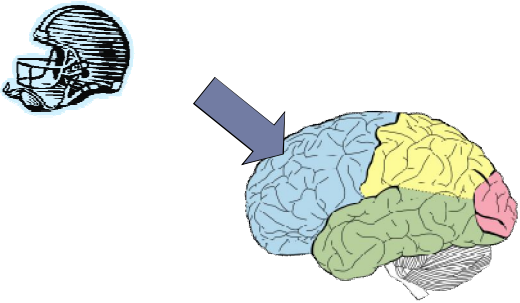
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WHAT is Working Memory?



Improving Working Memory, Alloway 2010 (Sage Publications)

Working memory in the brain







Not short-term memory

- Short-term memory = Remember
- Working memory = Remember + WORK

- Dog Cat Bat
- = Short-term memory


- Dog Cat Bat: RHYME?
- = WORKing memory

Working Memory: Lifespan

- 5 years 
- 10 years 
- 15 years 
- 60 years 

Alloway, TP., Davis, H., & Alloway, RG (2011)

Is working memory the same?



WHY is Working Memory important?

Working Memory Limits

- SPACE: Too much information
-
- TIME: Information given too quickly
- EFFORT: Trouble keeping track of information

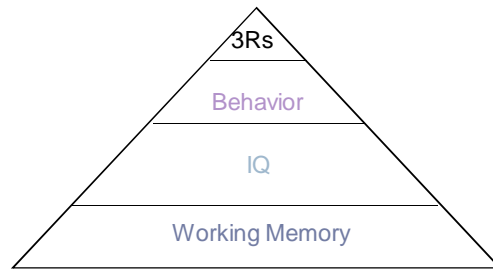
Improving Working Memory, Alloway 2010 (Sage Publications)

Working Memory & Environment

- WM doesn't depend on:
 - Financial background
 - Mother's educational level
- Pure measure of our ability
- Not what we have already learned

Alloway et al (2005) British J of Developmental Psy

Learning Pyramid



Improving Working Memory, Alloway 2010 (Sage Publications)

Letters & Numbers



- 3Rs: Reading, Writing, Arithmetic
- Important for learning
- But it is NOT enough!
 - Children with learning difficulties
 - 2 years later: No improvement in learning outcomes

Alloway (2009) European J. of Psy Assessment

Behavior




- Children with working memory problems:
 - NOT hyperactive or impulsive

Alloway et al. (2010) Child Psychiatry and Human Development

IQ


- Crystallized skills
- Fluid skills
- Linked to learning outcomes
- Many students with high IQ DON'T do well



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Working Memory & Language


- Letters + sounds
- Comprehension
- Put them together
- Poor working memory = poor language



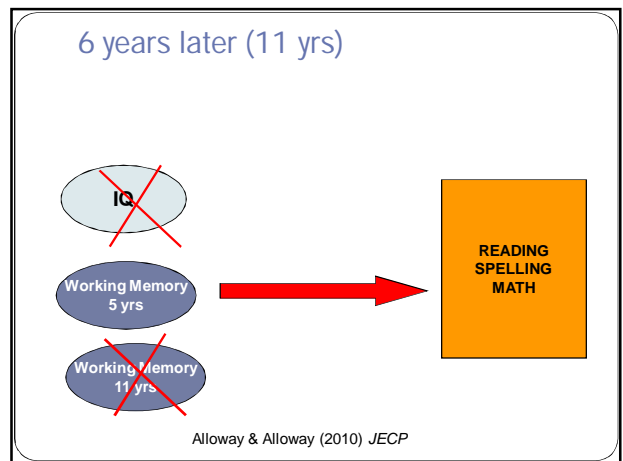
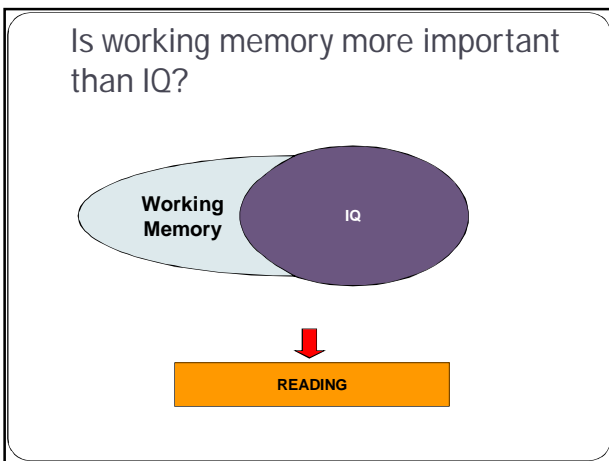
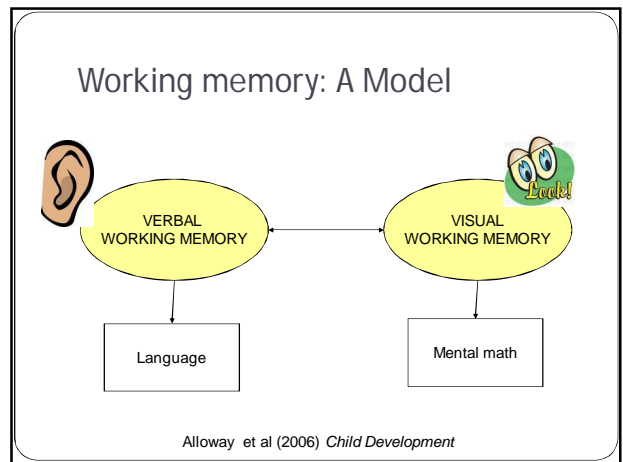
Cowan & Alloway (2008) *Development of Memory in Infancy & Childhood*

Working Memory & Math

- Learn math facts
- Mental blackboard
- Word problems
- Poor working memory = poor math



Cowan & Alloway (2008) *Development of Memory in Infancy & Childhood*



HOW do we measure Working Memory?

Micro ← → Macro

Functional Imaging Cognitive Behavior

The diagram shows a horizontal axis with 'Micro' on the left and 'Macro' on the right. Below the axis, three categories are listed: 'Functional Imaging', 'Cognitive', and 'Behavior'. Under 'Functional Imaging' is a brain scan image. Under 'Cognitive' is the AWMA logo. Under 'Behavior' is the WJARS logo.

HOW do we measure Working Memory?

- Automated Working Memory Assessment
 - <http://www.pearson-uk.com/AWMA>
- Only standardised tool for educators
- Online, self-directed version: Late 2011

Reliability

- Time sampling:
 - Consistent or Fluctuates?
- Test-retest reliability is strong (.79 to .90)

Two circles are shown side-by-side, one labeled 'Time 1' and one labeled 'Time 2', representing two separate measurement occasions.

Alloway et al. (2006) Child Development

Validity

- AWMA and other cognitive skills
 - WM = IQ?
- Range of samples: Verbal & Performance IQ
 - Typically developing students
 - Learning difficulties
 - Dyslexia, ADHD, ASD, DCD, Borderline IF
 - Gifted students

Validity


- What do AWMA scores tell us?
- Learning Outcomes
 - Low WM: 98% of students below-average scores
 - Alloway et al., (2009) Child Development*
 - Students with LD: WM predicts attainment scores 2 years later
 - Alloway (2009) European J of Psy Assessment*
 - Longitudinal: WM at 5 years is excellent predictor of attainment scores 6 years later
 - Alloway & Alloway (2010) J of Experimental Child Psychology*

HOW do we measure Working Memory?

- Behavior: Working Memory Rating Scale
- 20 items
- Abandons activities before completion

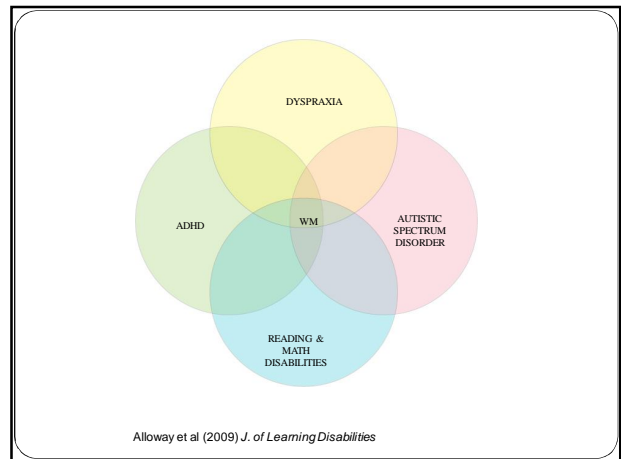
A horizontal axis with an arrow pointing right, labeled with 'Not typical', 'Occasionally', 'Fairly typical', and 'Very typical' from left to right.

Validity



- Other measures of classroom behavior
 - Conners' Teacher Rating Scale
 - Behavior Rating Inventory of Executive Function (BRIEF)
- Both scales only identify 24% of students with WM difficulties (w/o ADHD)

Alloway et al. (2010) *Child Psychiatry & Human Development*



CLASSROOM STRATEGIES

Working Memory Learning
A Practical Guide for Teachers
Susan E. Gathercole & Tracy Packiam Alloway

Improving Working Memory
Supporting Students' Learning
Tracy Packiam Alloway

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Dyslexia

- Symptoms
 - Difficulty with spelling
 - Confusion over left and right
 - Writing letters or numbers backwards
 - Difficulty with sequencing information
 - Math: Number lines
 - Following 2- or 3-step instructions

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Dyslexia: Working Memory

- Phonological processing is slow
 - Longer to connect letters with sounds
 - Mix up longer words
- Rehearsal: Not cumulative
- Articulation rate: Slower

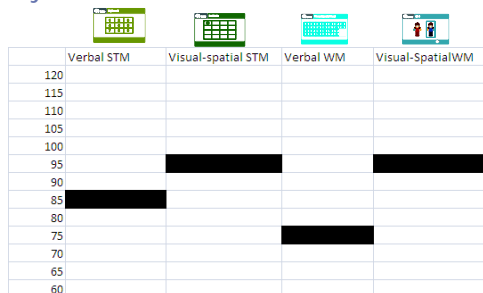
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Language Impairment

- Symptoms
 - Delayed language development
 - Normal IQ
 - Not linked with hearing loss or physical problems such as cerebral palsy

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Dyslexia & LI



Archibald & Alloway (2008) *Intl Journal of Speech & Language Disorders*

Dyslexia and LI: Why?

- Limit: TIME
- Speed of rehearsal
- Use of rehearsal
- Type of rehearsal
 - Brain imaging

Language Impairment

- Language or Working Memory = Learning difficulties?
- 2 groups with low WM:
 - 1 with language impairments
 - 1 with normal language
- Language: Normal language will have higher learning scores
- Memory: Both groups will have low learning scores
- Both groups had low scores in Reading & Math

Alloway & Archibald (2008) *Journal of Learning Disabilities*

Dyslexia: Working Memory Limits

- Verbal SPACE
- Verbal TIME
- Verbal EFFORT

Strategies: Verbal

- **SPACE**
 - Break down information
 - Create routines
 - Buddy or learning assistant

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Strategies: Verbal

- **TIME**
 - Teacher
 - Speak slowly
 - Repeat instructions
 - Record instructions
 - Students
 - Under 7 years: Don't rehearse
 - Say it out aloud

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Strategies: Verbal

- **EFFORT**
 - Simple language
 - To blow up parliament, Guy Fawkes used 36 barrels of gunpowder
 - Guy Fawkes used 36 barrels of gunpowder to blow up parliament.

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Strategies: Verbal

- **EFFORT**
 - Simple language
 - Math problems vertical not horizontal
 - History timeline

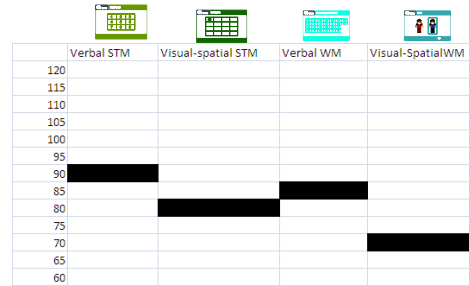
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Dyspraxia: Symptoms

- **Gross motor skills (large movements):**
 - Poor balance: Riding a bicycle
 - Poor hand-eye co-ordination: Catching a ball & batting
 - Exaggerated 'accessory movements': flapping arms when running
- **Fine motor skills (small movements):**
 - Lack of manual dexterity: using cutlery, craft work, playing musical instruments
 - Poor manipulative skills: Typing, handwriting and drawing, fastening clothes & tying shoelaces

Alloway (2006) Working Memory & Neurodevelopmental Disorders. Psy Press

Dyspraxia

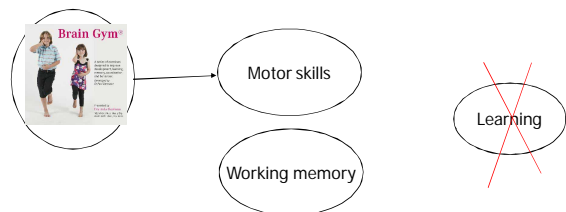


Alloway TP (2007) Journal of Experimental Child Psychology

Dyspraxia: Learning

- Motor skills or Working Memory = Learning difficulties?
- Two groups:
 - High Visual-Spatial Memory
 - Low Visual-Spatial Memory
- Motor skills: Both groups will have low learning scores
- Working Memory: Low VS Memory group will have lower learning scores
- Low Visual-Spatial Memory group performed worse in Reading & Math
 - Even after accounting for IQ

Alloway (2007) J. of Experimental Child Psychology



Alloway & Warner (2008) Perceptual & Motor skills

Dyspraxia: Working Memory Limits

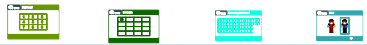
- Visuo-spatial SPACE
- Visuo-spatial EFFORT

Strategies: Visual

- **EFFORT**
 - 'I need to have them written down, they don't stay in my head'.
- Teach students how to use visual aids
- Organizational strategies
 - How are two concepts connected?

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ADHD



	Verbal STM	Visuo-spatial STM	Verbal WM	Visuo-Spatial WM
120				
115				
110				
105				
100	■			
95		■		
90				
85			■	
80				■
75				
70				
65				
60				

Alloway TP et al (2010) *Developmental Medicine & Child Neurology*

ADHD: Working Memory Limits

- Verbal & Visuo-spatial TIME
 - The 'U' of Memory
 - Short activities: 10-20 minutes
 - Use a Timer
- Verbal & Visuo-spatial EFFORT
 - Do an action

Strategies: Visual

- **TIME**
 - Useful spellings: Starter words
 - Tomorrow
 - Because




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ADHD

- Visuo-spatial working memory: Best single predictor of ADHD out of other cognitive measures
- Linked to learning difficulties independent of IQ

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Autistic Spectrum Disorder



	Verbal STM	Visual-spatial STM	Verbal WM	Visual-SpatialWM
120				
115				
110				
105				
100				
95				
90				
85				
80				
75				
70				
65				
60				

Alloway TP et al (2009) *J of Learning Disabilities*

Autism: Working Memory Limits

- Verbal & Visuo-spatial EFFORT
- Physical Environment

Strategies: Long-term

- Mnemonics
 - **Because** - Big Elephants Can Always Understand Small Elephants
- Associations
 - I went shopping to buy an Apple, Banana, Carrot
 - Memory whiz


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Strategies: Student

- Meta-cognitive skills
 - **What** strategy did you use?
 - **Why** did it work?
 - **When** will it work again?
 - **How** can we make the strategy better?


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Strategies: Student

- Think aloud
 - Test yourself instead of restudying material
 - 50%  compared to just reading
 - How? Periodically
- Talk aloud
 - More helpful than summary points
 - Work in pairs

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<http://www.junglememory.com>



Quicksand

Think fast!
Remember locations of letters and words to improve mental processing.

Code Breaker

Crack the code!
Challenge spatial skills with complex letter rotations to boost reading skills.

River Crossing

Solve the problem!
Improve working memory with math problems that increase in difficulty as you progress.

Daily Feedback

Track progress.
See daily improvement and compare performance to peers.

Key Features of Jungle Memory

Stats for Fred

Chart 1 shows how much you have improved since you started playing Jungle Memory.

Chart 2 shows you where you stand in a line of 100 children of the same age?

Chart 3 shows you where you stand in a line of 100 children of the same age for each game. The higher the better, the better you are.

River Crossing

Quickstart

Code Breaker

Log

Week	Total Days
Week 1	1
Week 2	2
Week 3	3
Week 4	4

Key Features of Jungle Memory

- Bonus features: FUN!

CODE BREAKER

TRIAL 10/10
LEVEL 03

Good job!
Memory level has improved!

HOME TRIALS

Transfer to academic grades?

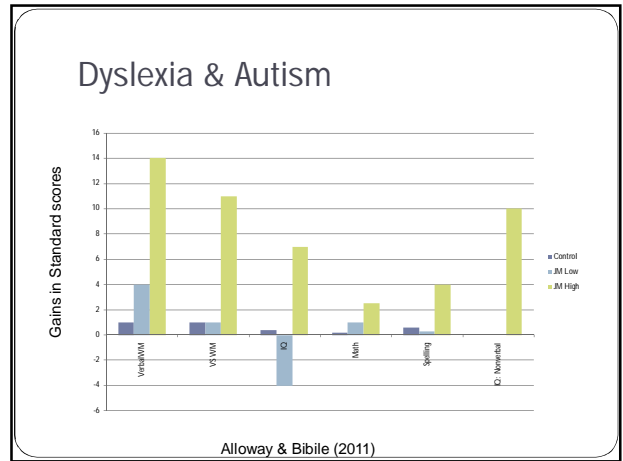
JUNGLEMEMORY

C to B
B to A

TUITION ONLY

IQ
GRADES: LITERACY & MATH

Alloway (2009) PATOSS; Nature Proceedings



SUMMARY

- Working Memory is the #1 predictor of academic success.
- Without training, working memory will not improve.
- We **CAN** train working memory and support successful learning.

RESOURCES

www.junglememory.com/offer/rm25discount

www.psychcorp.co.uk/AWMA

www.psychcorp.co.uk/WMRS

www.tracyalloway.com

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