Memory and how it works

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We all need a mental notepad

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- You're given a local 6-digit telephone number and have to go next door to find a pen to write it down

- Try following instructions when you're di

"When you pass the church
and take the

you can no longer see

oregano, 2 tsp cinnamon,½ tsp chilli powder, a tablespoon of sugar, 2 tablespoons of lime juice

Working memory

- You're in the supermarket with only £10 cash in your pocket. You'll just have to add up total as you shop.

So many kinds of memory to choose from …

Semantic memory

Facts, knowledge
Lasts for: a lifetime, potentially

Examples:

- knowing that Paris is the capital of France
- knowing the meaning of words

So many kinds of memory to choose from …

Autobiographical memory

Memories from across your life, and your personal history
Lasts for: a lifetime

It's nothing like: a video recording

Examples:

- first day at school
- a friend's wedding

So many kinds of memory to choose from …

Episodic memory

Details of recent experiences
Lasts for: up to several days, can be more

Examples:

- Breakfast this morning
- Where's the car??

The most temporary of all ……

Working memory

Very recent information that we have attended to

Lasts for: seconds, unless we rehearse

- Limited in capacity
- Requires continued attention
- Catastrophic loss

Let's recap

Semantic memory	facts
Autobiographical memory	life events and knowledge
Episodic memory	specific recent events
Working memory	recent information

Remember a quotation from a Shakespeare play that you studied at school

Semantic memory	facts
Autobiographical memory	life events and knowledge
Episodic memory	specific recent events
Working memory	recent information

12 x 9 = ?

Semantic memory	facts
Autobiographical memory	life events and knowledge
Episodic memory	specific recent events
Working memory	recent information

124 x 45 =

Semantic memory	facts
Autobiographical memory	life events and knowledge
Episodic memory	specific recent events
Working memory	recent information

Where did you leave the house keys?

Semantic memory	facts
Autobiographical memory	life events and knowledge
Episodic memory	specific recent events
Working memory	recent information

You disagree with a friend about who else was at a party a couple of years ago

Semantic memory	facts
Autobiographical memory	life events and knowledge
Episodic memory	specific recent events
Working memory	recent information

Amazing luck – there was an exam question that corresponded directly to last-minute revision

Semantic memory	facts
Autobiographical memory	life events and knowledge
Episodic memory	specific recent events
Working memory	recent information

Even better: there was another question on the topic on which you had already done an essay and given a presentation

Semantic memory	facts
Autobiographical memory	life events and knowledge
Episodic memory	specific recent events
Working memory	recent information

Tree yielding acorn (3)

Semantic memory	facts
Autobiographical memory	life events and knowledge
Episodic memory	specific recent events
Working memory	recent information

Key your PIN number into an ATM bank machine

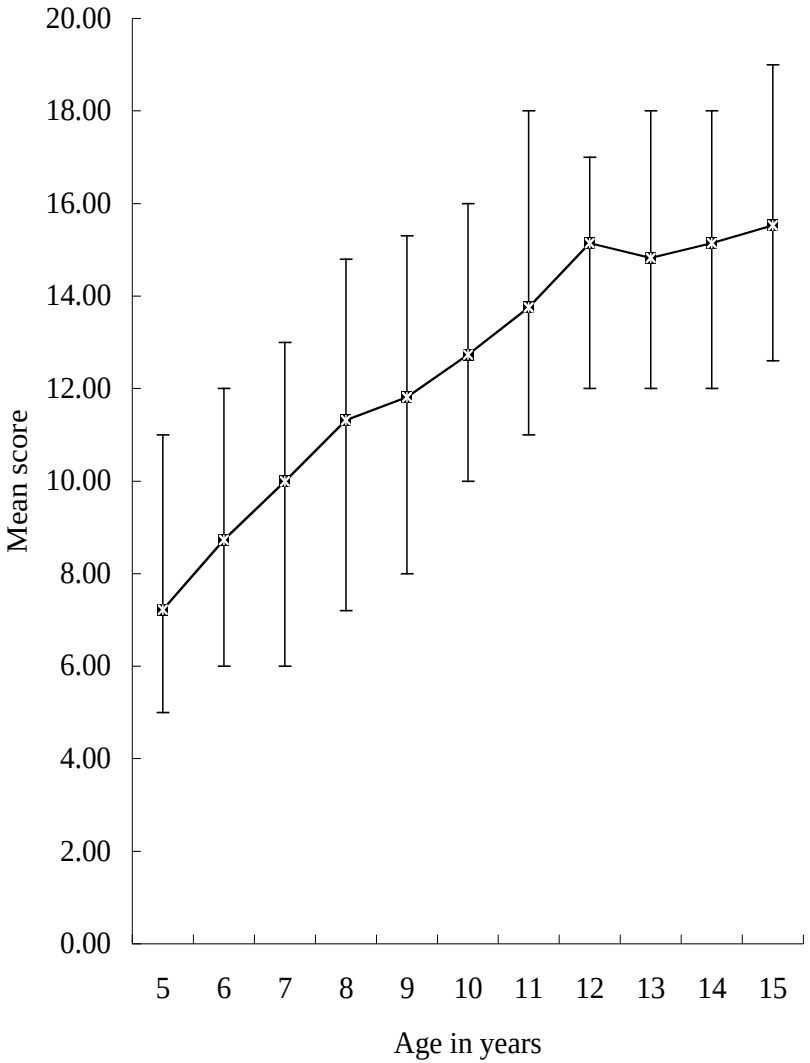
Semantic memory	facts
Autobiographical memory	life events and knowledge
Episodic memory	specific recent events
Working memory	recent information

Re-type a new password that you have just created

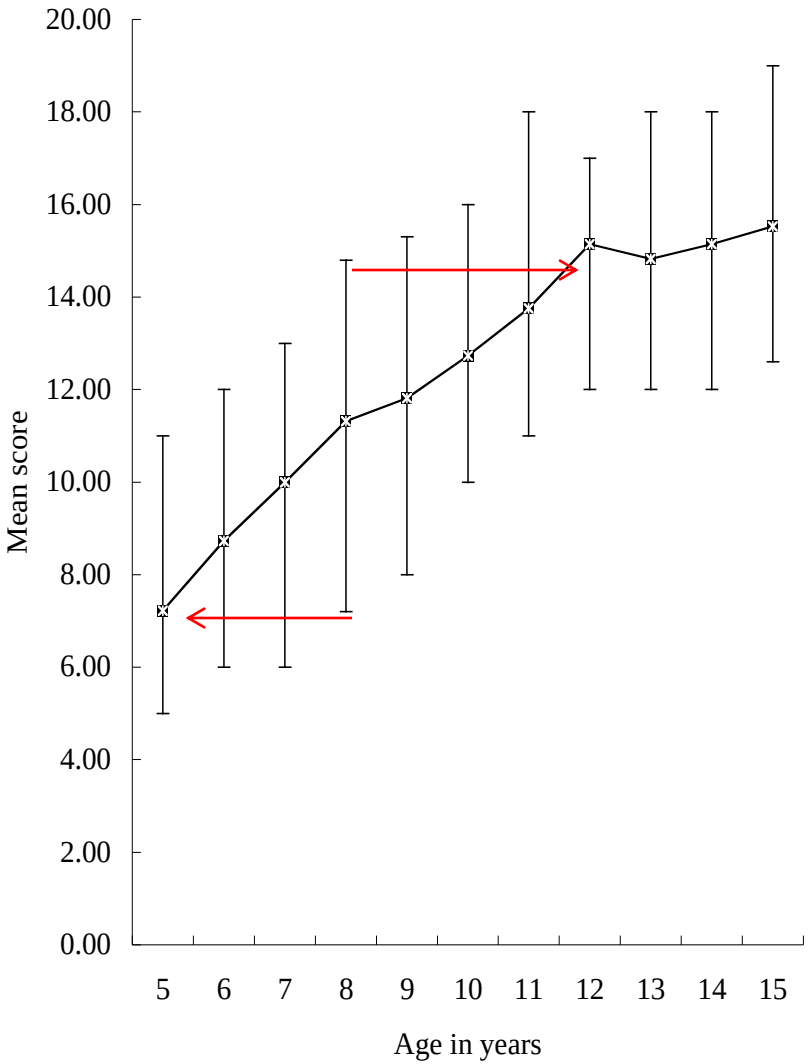
Semantic memory	facts
Autobiographical memory	life events and knowledge
Episodic memory	specific recent events
Working memory	recent information

Working (or short-term) Memory

WM capacity varies with age and across individuals



WM ability varies with age and across individuals



Low WM abilities are common

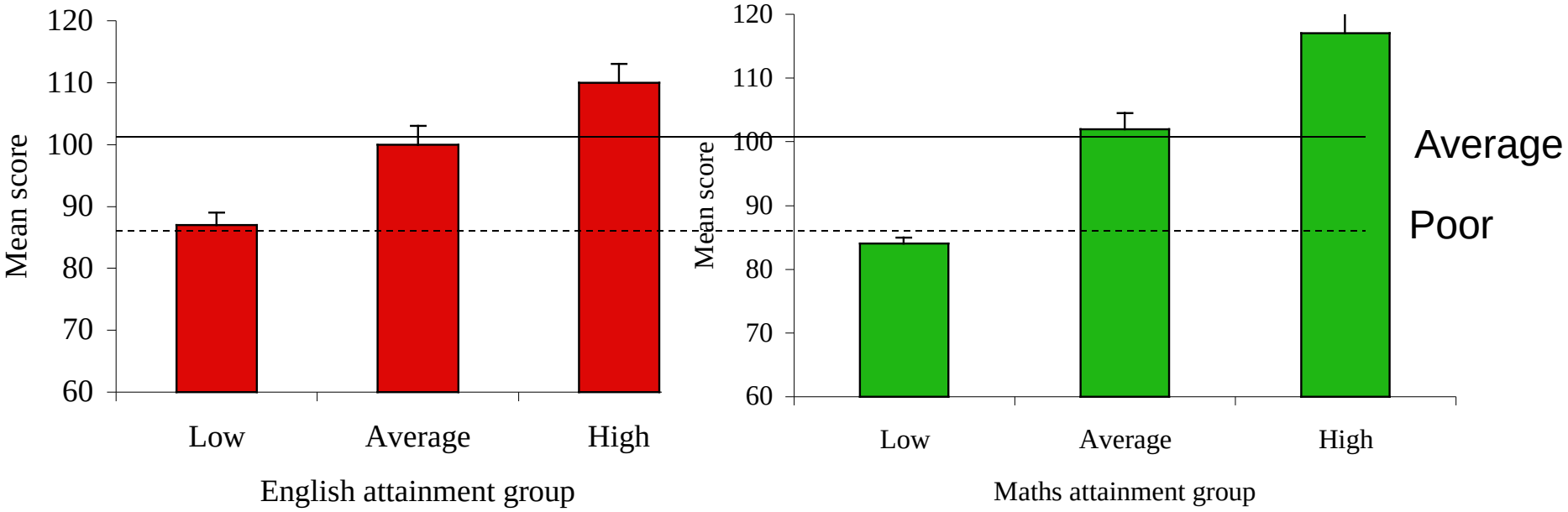
Developmental conditions

- Reading difficulties/ dyslexia
- Mathematical difficulties/ dyscalculia
- Language Impairment
- ADHD
- Genetic disorders – Downs, Williams, Fragile X

Acquired conditions

- Hypertension
- Head injury
- Anxiety
- Depression

Low WM places a child at risk of poor academic attainment: WM scores by age 11 SATs levels



Gathercole et al. (2004)

Characteristics of children with low WM

- Poor academic progress

More than 80% of children with poor working memory fail to achieve expected levels of attainment in either reading or maths, typically both (Gathercole & Alloway, 2008)

Characteristics of children with low WM

- Poor academic progress
- Difficulties in following instructions

"Put your sheets on the green table, arrow cards in the packet, put your pencil away and come and sit on the carpet."

John (6 years) moved his sheets as requested, but failed to do anything else. When he realized that the rest of the class was seated on the carpet, he went and joined them, leaving his arrow cards and pencil on the table.

Characteristics of children with low WM

- Poor academic progress
- Difficulties in following instructions
- Place-keeping difficulties

Characteristics of children with low WM

- Poor academic progress
- Difficulties in following instructions
- Place-keeping difficulties
- Teachers say: short attention span and highly distractible

"he's in a world of his own"
"he doesn't listen to a word I say"
"she's always day-dreaming"
"with him, it's in one ear and out of the other"

Is low WM a form of AD(H)D?

ADHD:
DSM-IV symptoms of *inattention*

At least 6 of the following:

- Often does not give close attention to details or makes careless mistakes in schoolwork, work, or other activities
- Often has trouble keeping attention on tasks or play activities
- Often does not seem to listen when spoken to directly
- Often does not follow instructions and fails to finish schoolwork, chores, or duties in the workplace
- Often has trouble organizing activities
- Often avoids, dislikes, or doesn't want to do things that take a lot of mental effort for a long period of time
- Often loses things needed for tasks and activities
- Is often easily distracted
- Is often forgetful in daily activities

Symptoms displayed by children with poor working memory

- Often does not give close attention to details or makes careless mistakes in schoolwork, work, or other activities
- Often has trouble keeping attention on tasks or play activities
- Often does not seem to listen when spoken to directly
- Often does not follow instructions and fails to finish schoolwork, chores, or duties in the workplace
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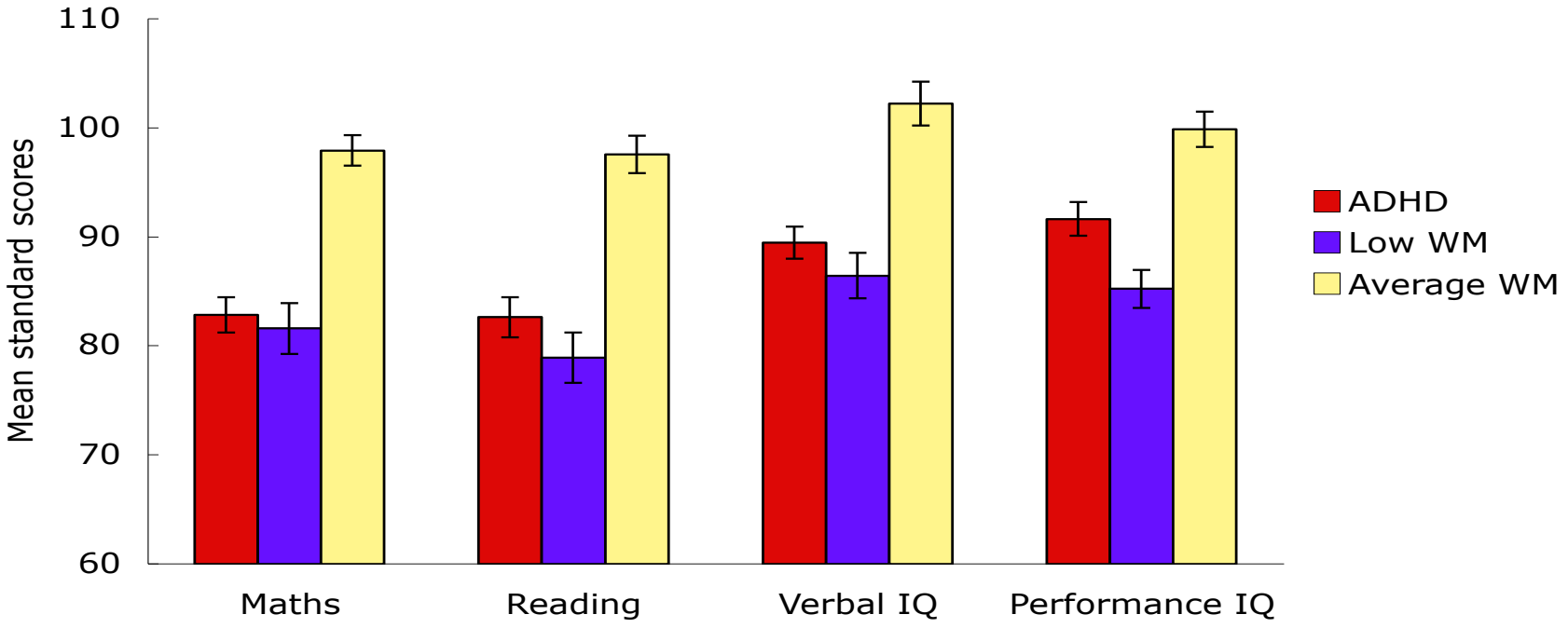
Gathercole & Alloway (2008), Gathercole, Alloway, Elliott, & Kirkwood (2008)

But the learning difficulties are the same



Holmes et al. (2014)

Is low WM a form of AD(H)D?

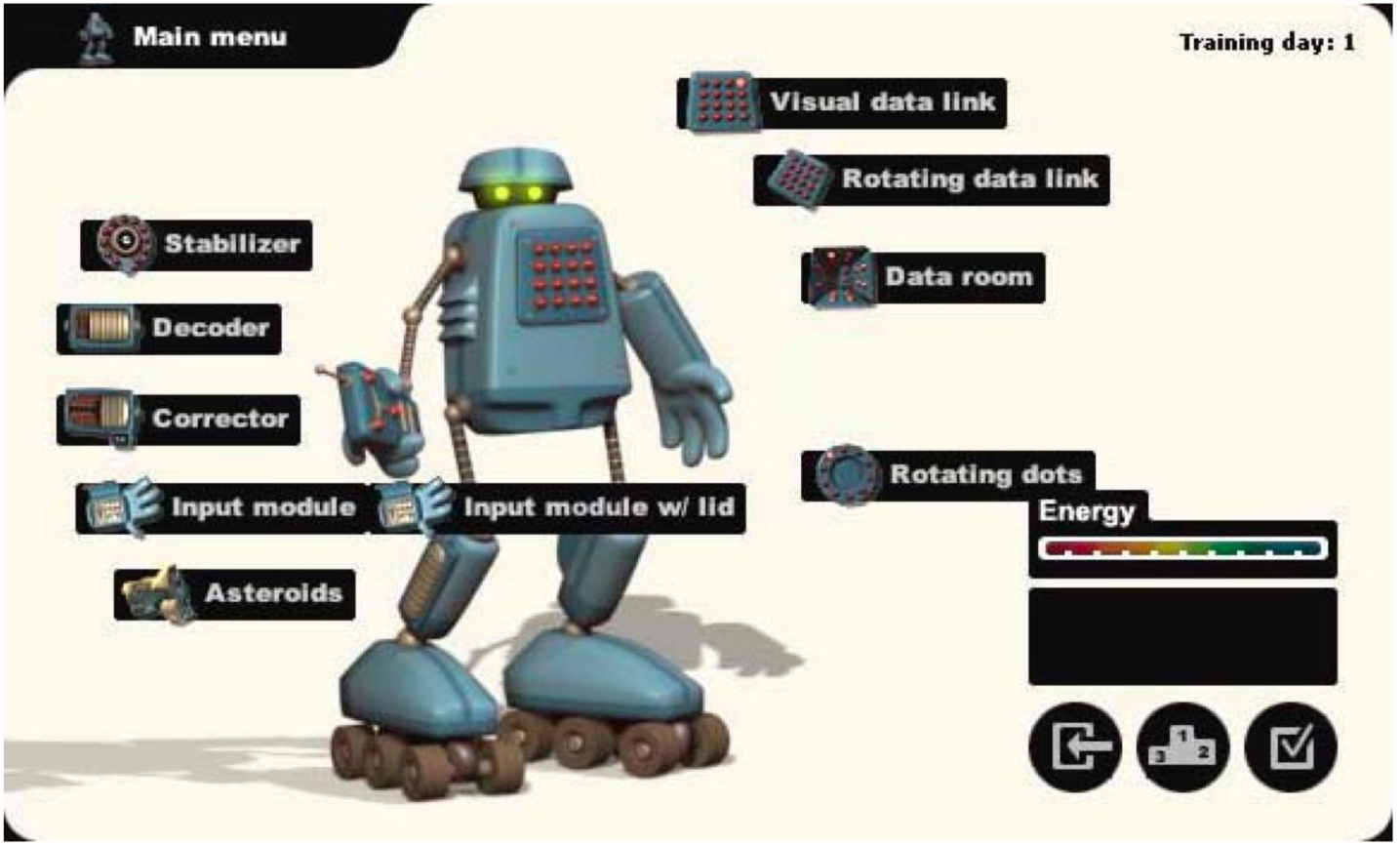
ADHD = +hyperactive, +inattentive, -WM

ADD/ low WM = -hyperactive, +inattentive, -WM

Holmes et al. (2014)

What can be done to help individuals with poor WM?

WM training: Cogmed



Two Cogmed training activities

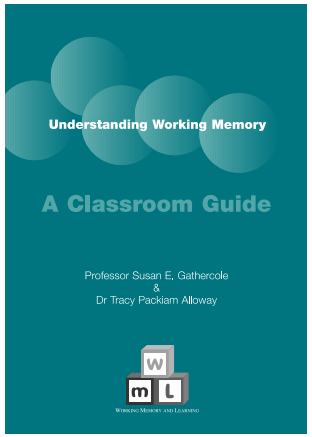
Does training work?

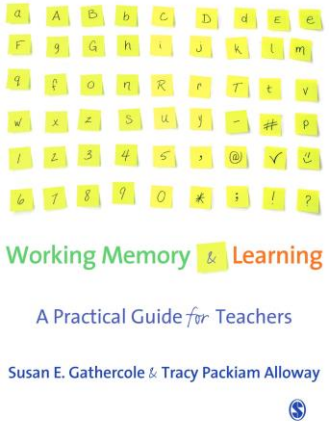
Not really:

- WM performance improves and the benefits persist…
- … but only when the training involves an unusual activity (e.g., backward span) common also the untrained task
- No advantages to learning, or attention, or other WM activities
- We think: WM training involves learning to do something unusual and new, and does not boost WM capacity itself

Classroom management of WM

- Avoid WM overload and its impact on learning by:
- Reducing WM loads
- Using memory aids and strategies (relying on other kinds of memory)
- Train particular key tasks (but don't expect wide transfer)





Memory changes across adulthood

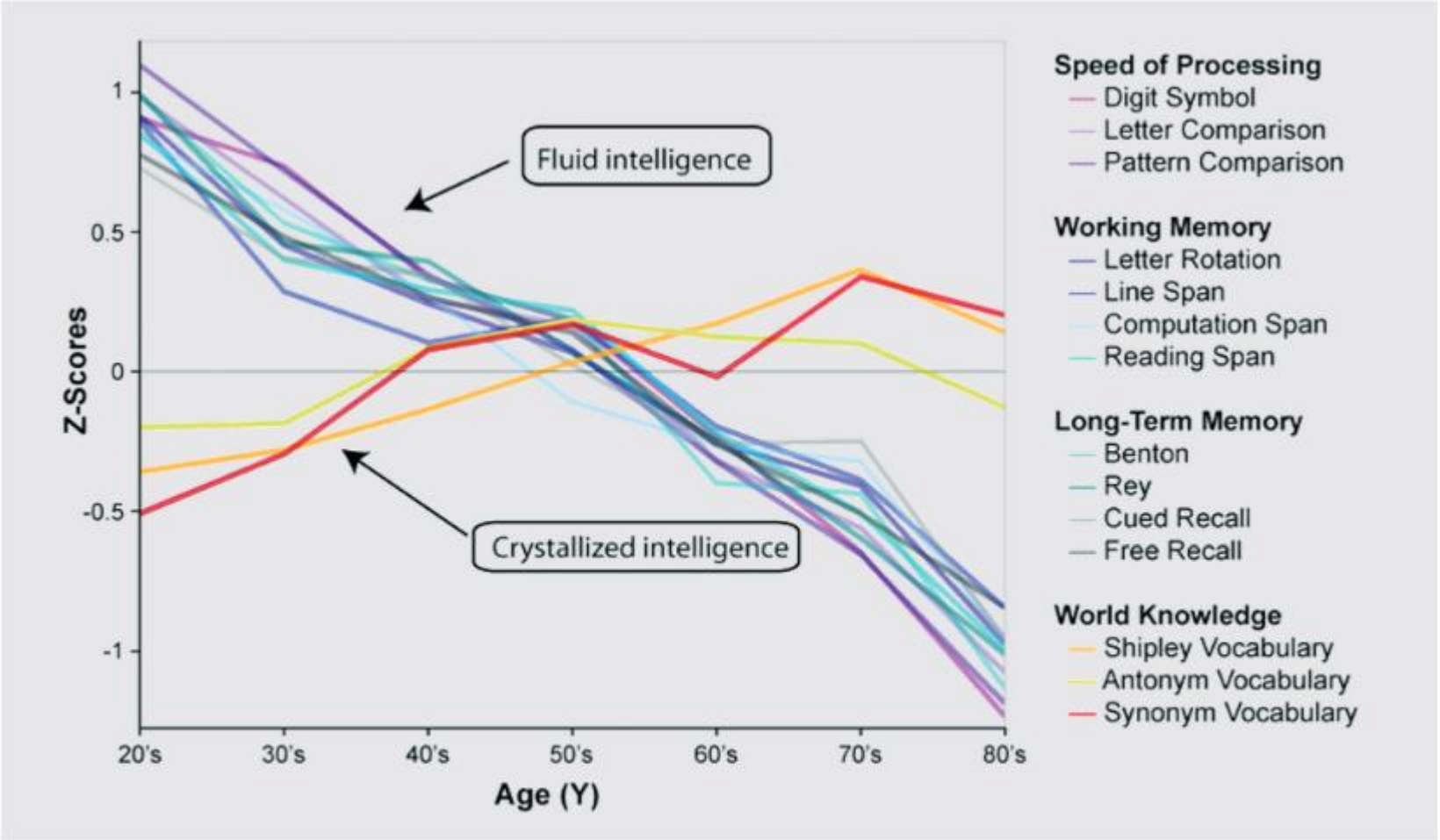
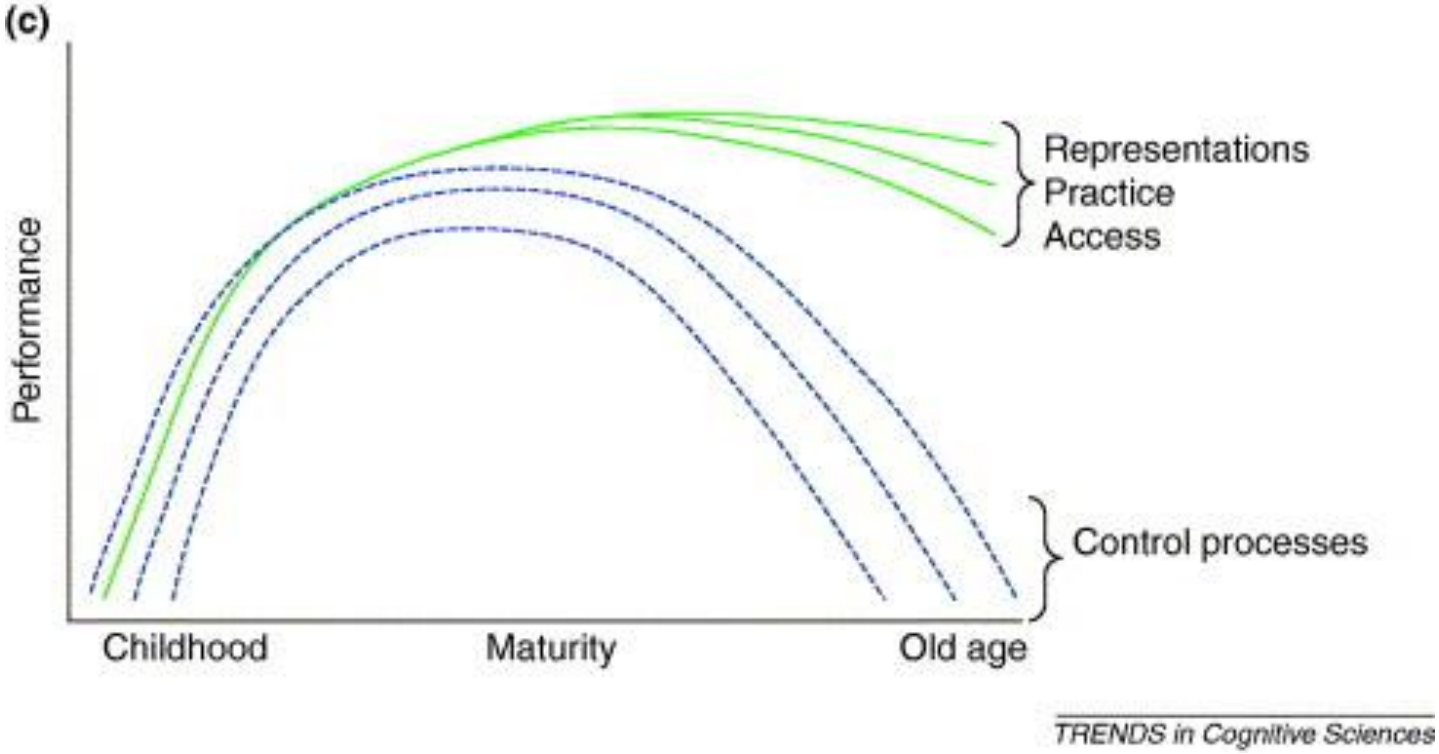


Figure 1. Cross-sectional aging data adapted from ref 9 showing behavioral performance on measures of speed of processing (ie, Digit Symbol, Letter Comparison, Pattern Comparison), working memory (ie, Letter rotation, Line span, Computation Span, Reading Span), Long-Term Memory (ie, Benton, Rey, Cued Recall, Free Recall), and world knowledge (ie, Shipley Vocabulary, Antonym Vocabulary, Synonym Vocabulary). Almost all measures of cognitive function (fluid intelligence) show decline with age, except world knowledge (crystallized intelligence), which may even show some improvement.

Memory changes across the lifespan



Conclusions

- Memory is important for everyday functioning
- There are multiple independent systems of memory
- No quick fixes to memory problems, but workarounds:
  - Mental strategies (rehearsal, mnemonics, imagery)
  - External strategies (diaries, prompts)
  - Trying to remember in a different way
  - Controlling the demands on your memory
- Across the adult years knowledge increases but more flexible cognitive abilities decline
- Our memory performance is the product of both