

Disorders of working memory: Causes and remediation

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WM: Key features

- Capacity to hold material in mind and manipulate as necessary for brief period
- Mental workspace
- Limited in capacity - varies between individuals

Children with low working memory

- Struggle at school because the working memory loads of individual learning activities are excessive
 - Fail to complete individual learning exercises
 - Over time, fail to accumulate knowledge and fall behind peers

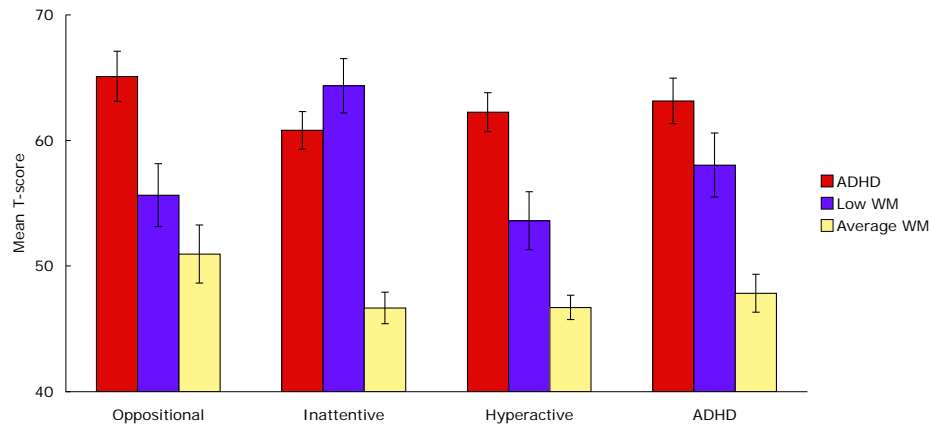
WM and Developmental Disorders

- Deficits in WM are a common feature in many acquired and genetic developmental disorders of learning
 - ADHD (Martinussen & Tannock, 2006)
 - Reading difficulties (Swanson, 2003)
 - Mathematical difficulties (Geary et al., 2004)
 - Specific Language Impairment (Archibald & Gathercole, 2007)
 - Dyslexia (Jeffries & Everatt, 2003, 2004)
 - Down syndrome (Jarrold, Baddeley & Hewes, 1999)
 - Williams syndrome (Jarrold, Baddeley, Hewes & Phillips, 2001)
- Profiles of children with ADHD and reading difficulties are similar to those of children poor WM

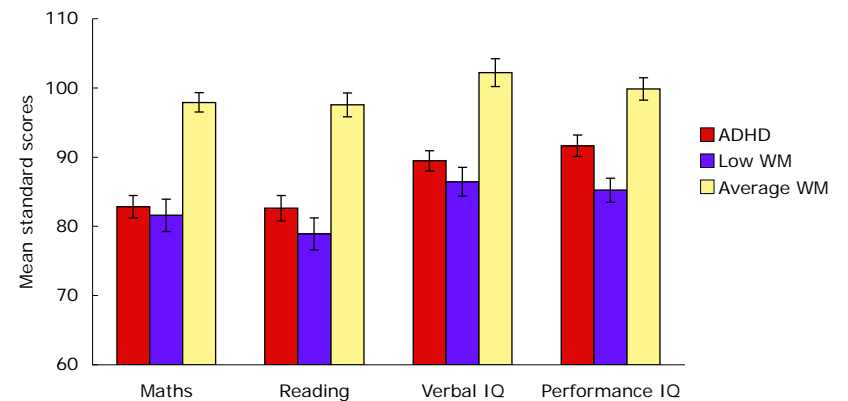
Children with low WM and children with ADHD

- 7- to 11-yr old children with:
 1. ADHD ($n=83$, no meds)
 2. low WM ($n=50$)
 3. typical WM ($n=50$)

Conners Teacher Behaviour Ratings

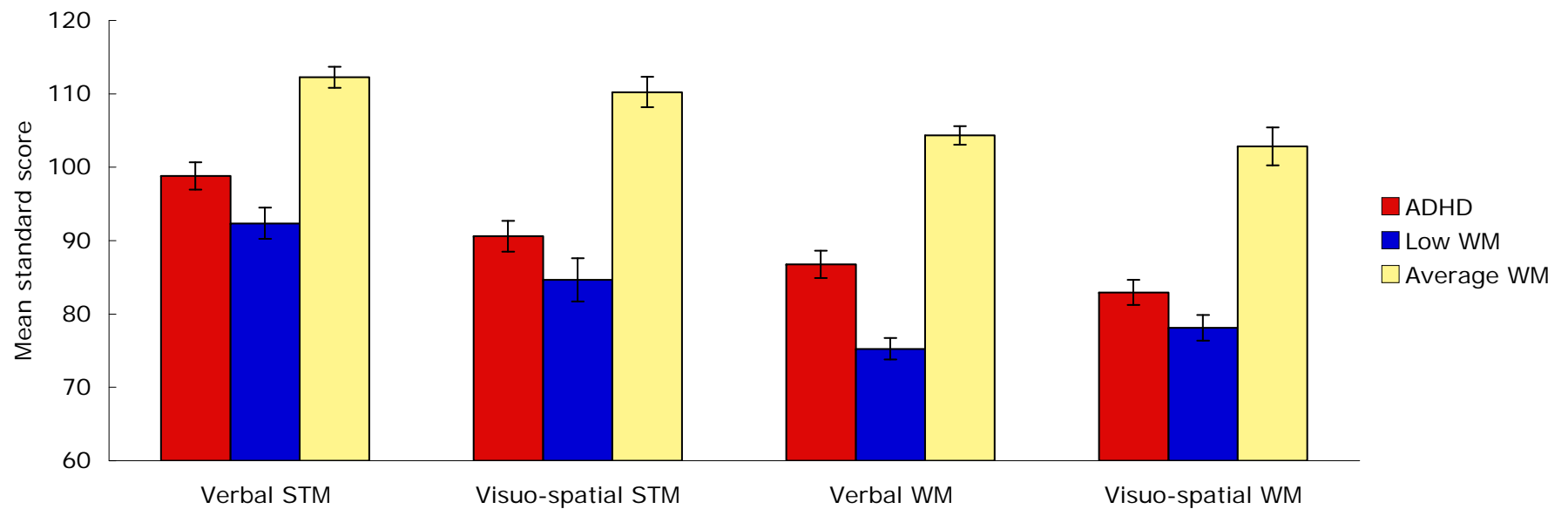


Attainment and IQ



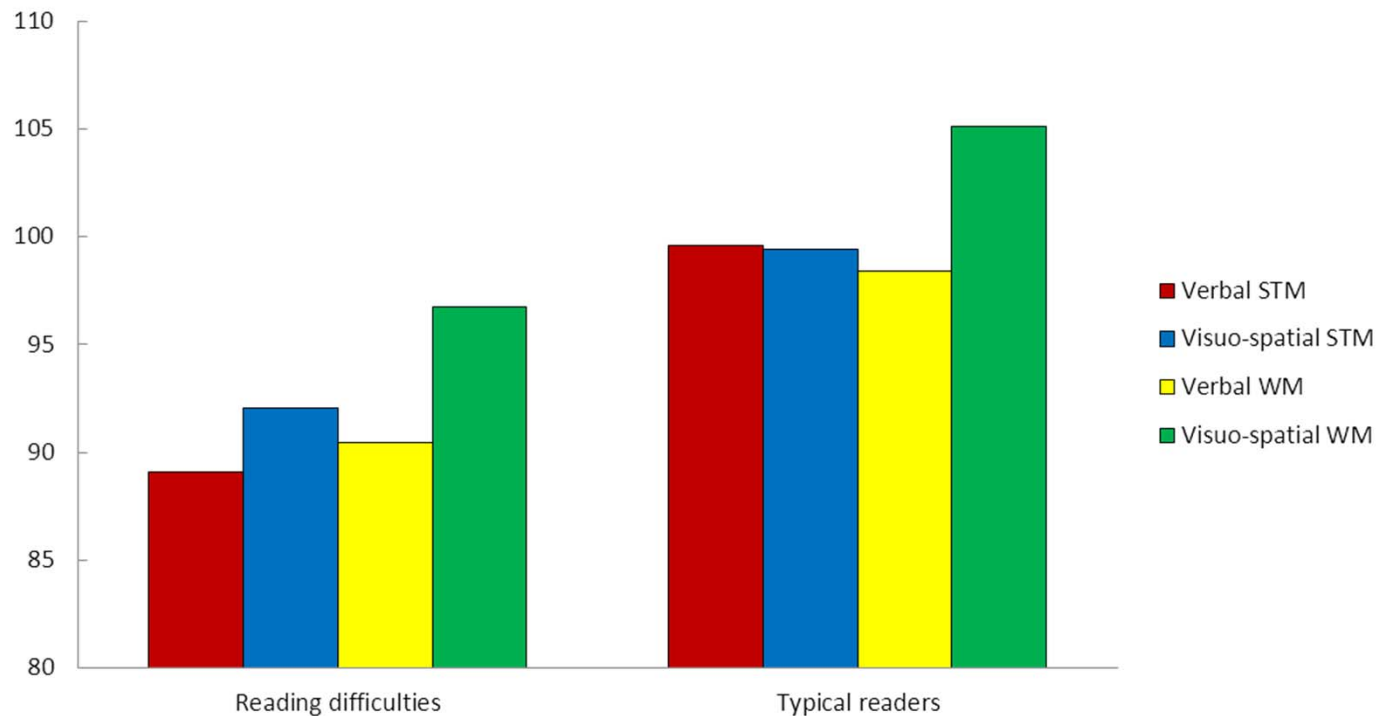
Holmes et al., in prep.

Working memory in ADHD and low WM



Working memory in poor readers

- 22 *poor readers* aged 8 – 10 years
- 23 *typical readers* matched for NVIQ



Wang & Gathercole, 2013

Low WM, ADHD and reading difficulties

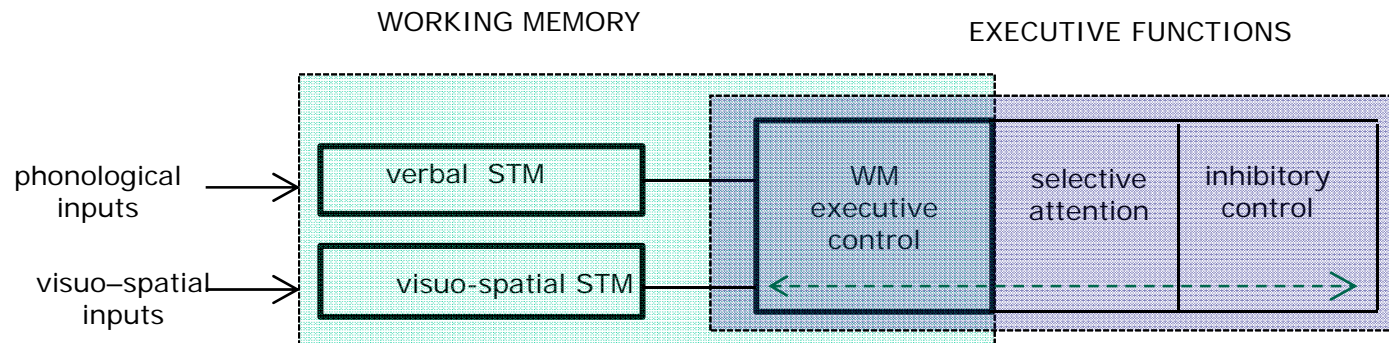
- Children with ADHD and those with low WM :
 - i. poor learners
 - ii. inattentive
 - iii. verbal and visuo-spatial WM difficulties
- Children with ADHD are more likely to behave impulsively
- Poor readers also show i and ii, but have greater verbal than visuo-spatial impairments

Two important questions

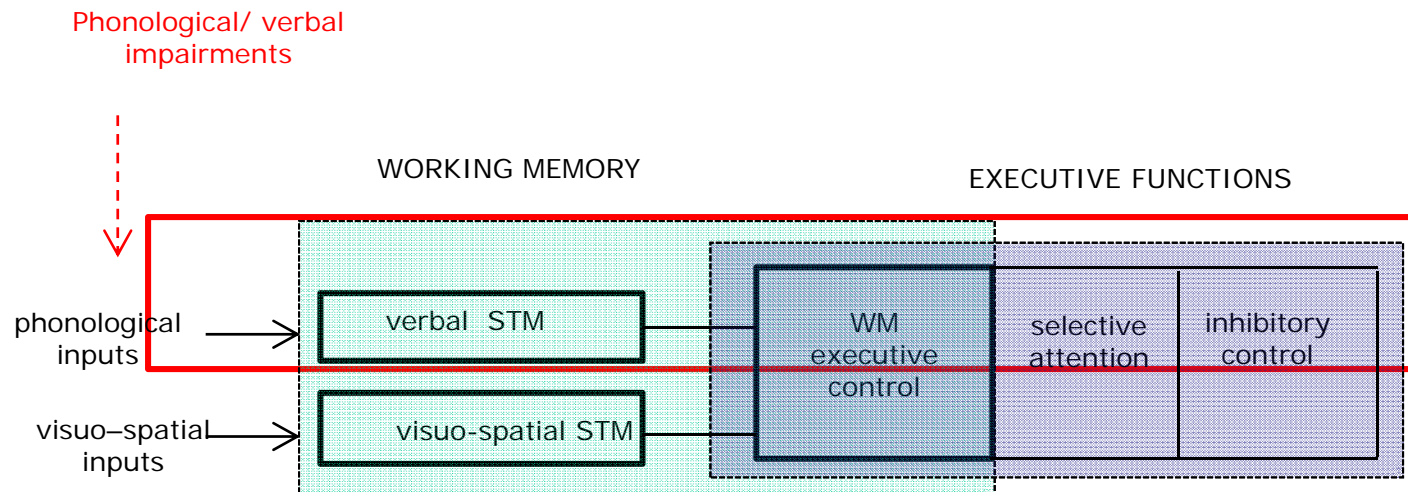
1. Are the WM deficits so commonly observed a core feature of different disorders?
2. Does the cause of the WM difficulty limit response to interventions targeted at WM?

1. Are WM deficits core to the disorder?

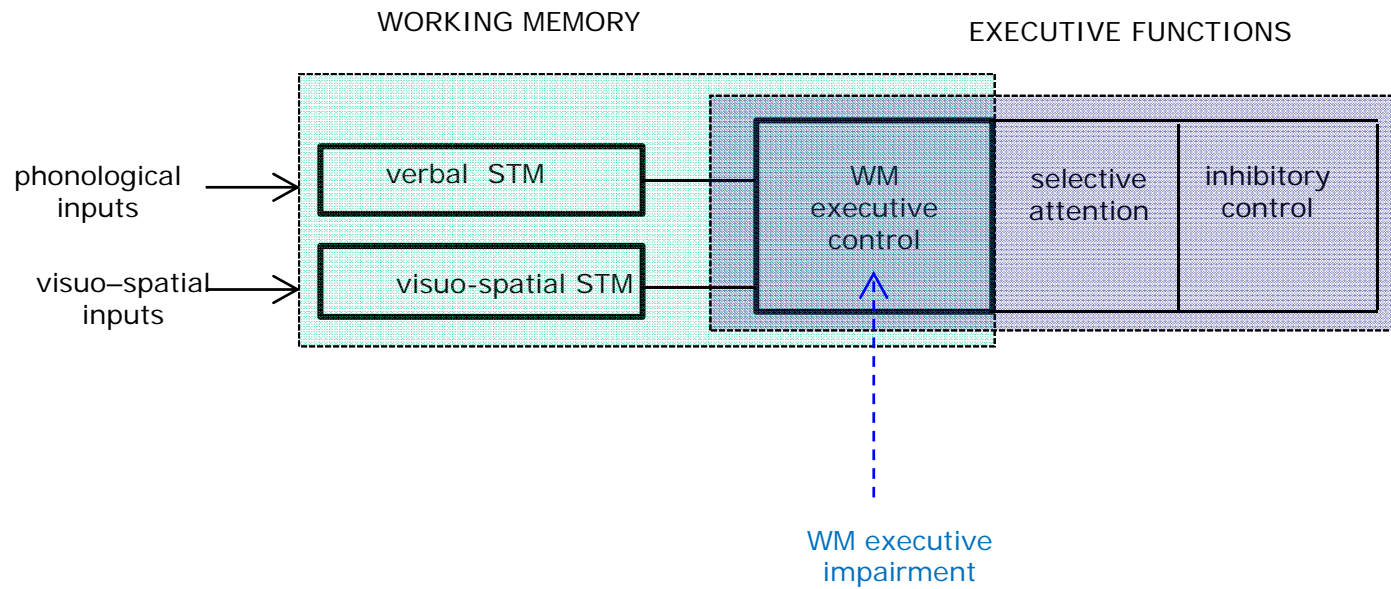
Working memory in its broader context



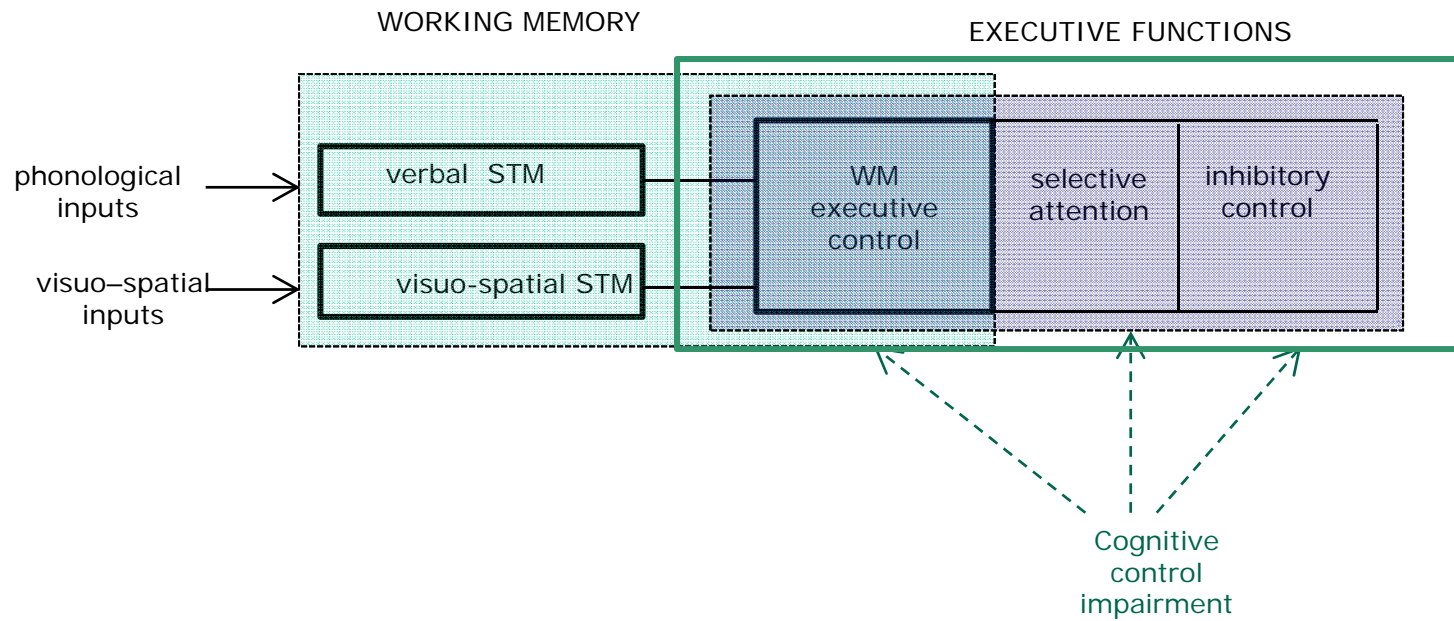
Potential sources of WM deficits



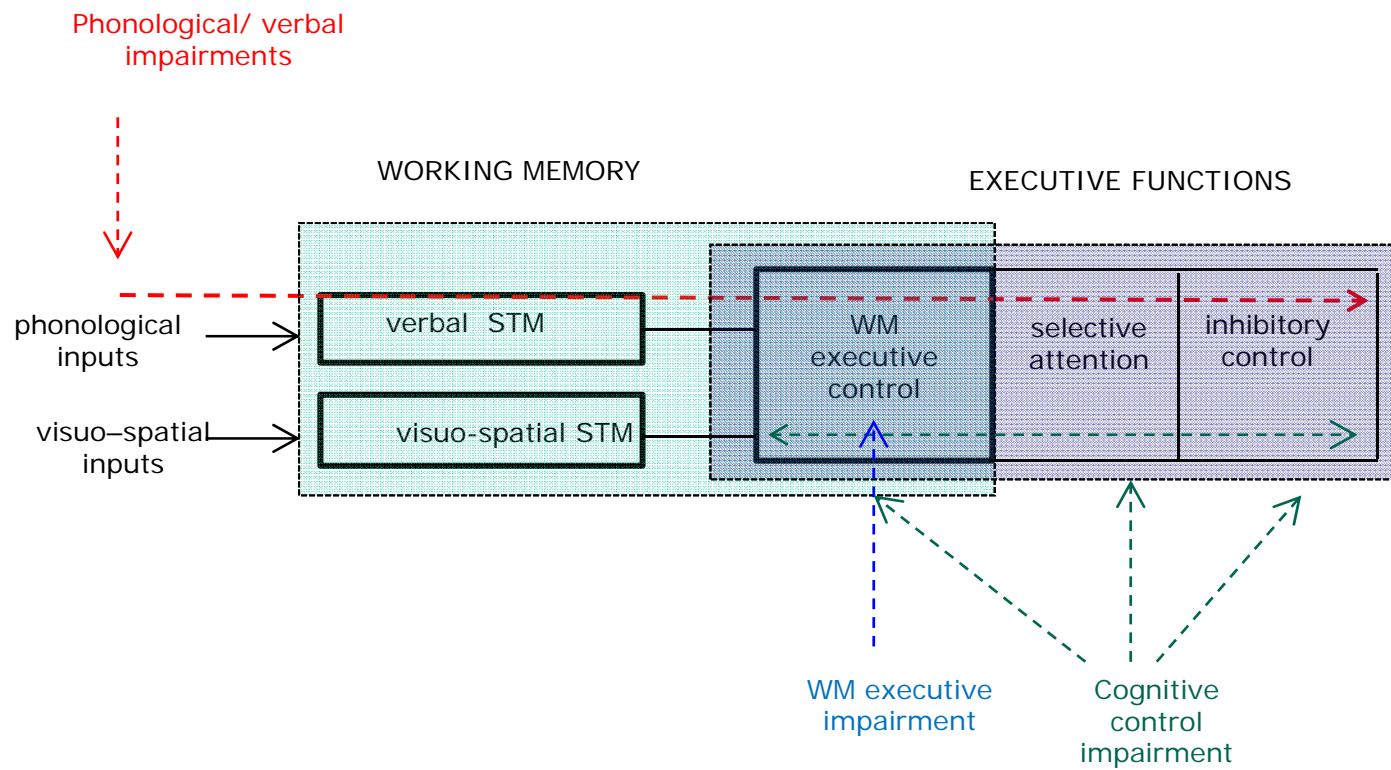
Potential sources of WM deficits



Potential sources of WM deficits

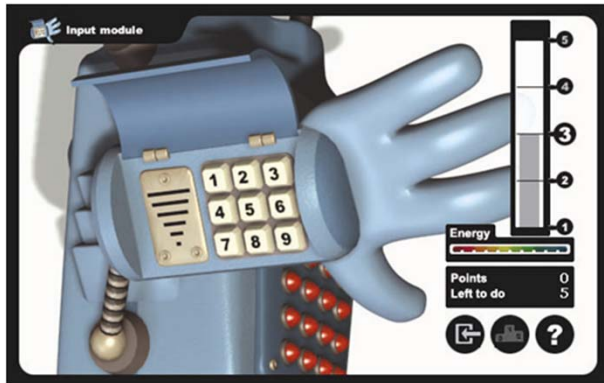


Potential sources of WM deficits



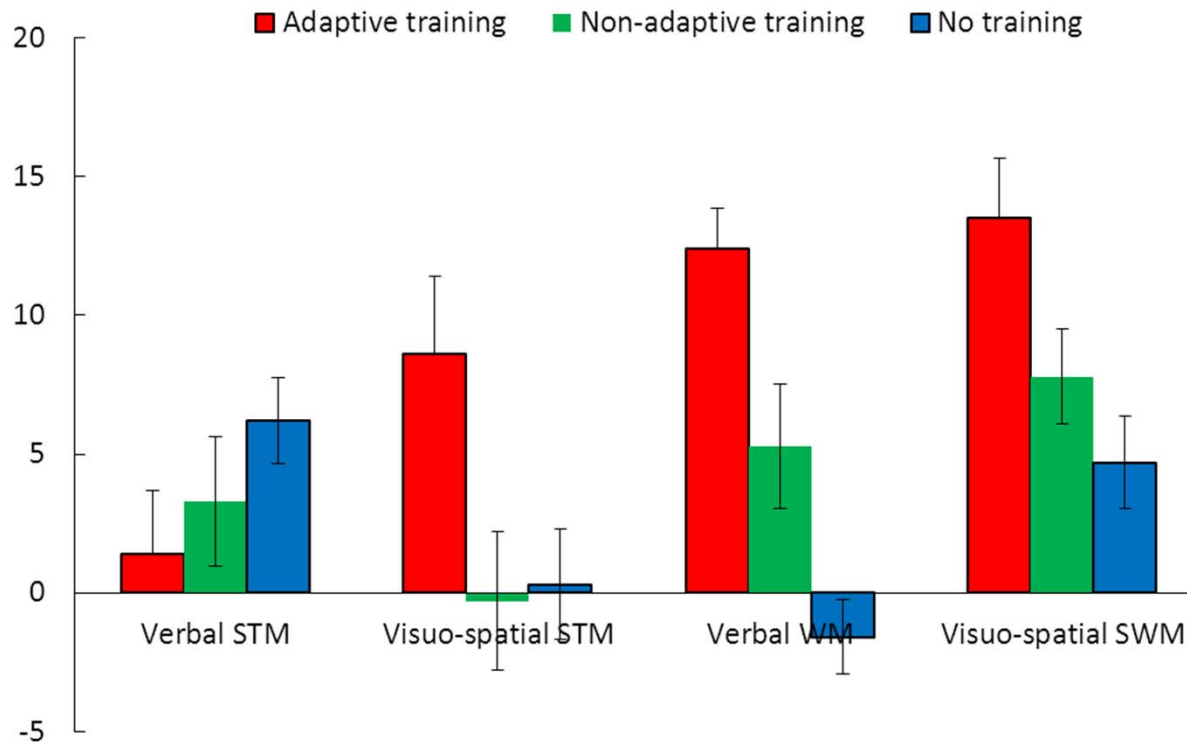
2. Does cause limit response to intervention?

- Computerised training programs, target working memory
- Train on working memory tasks for 25 sessions over a 6-8 week period
- Adaptive: individual works at span level



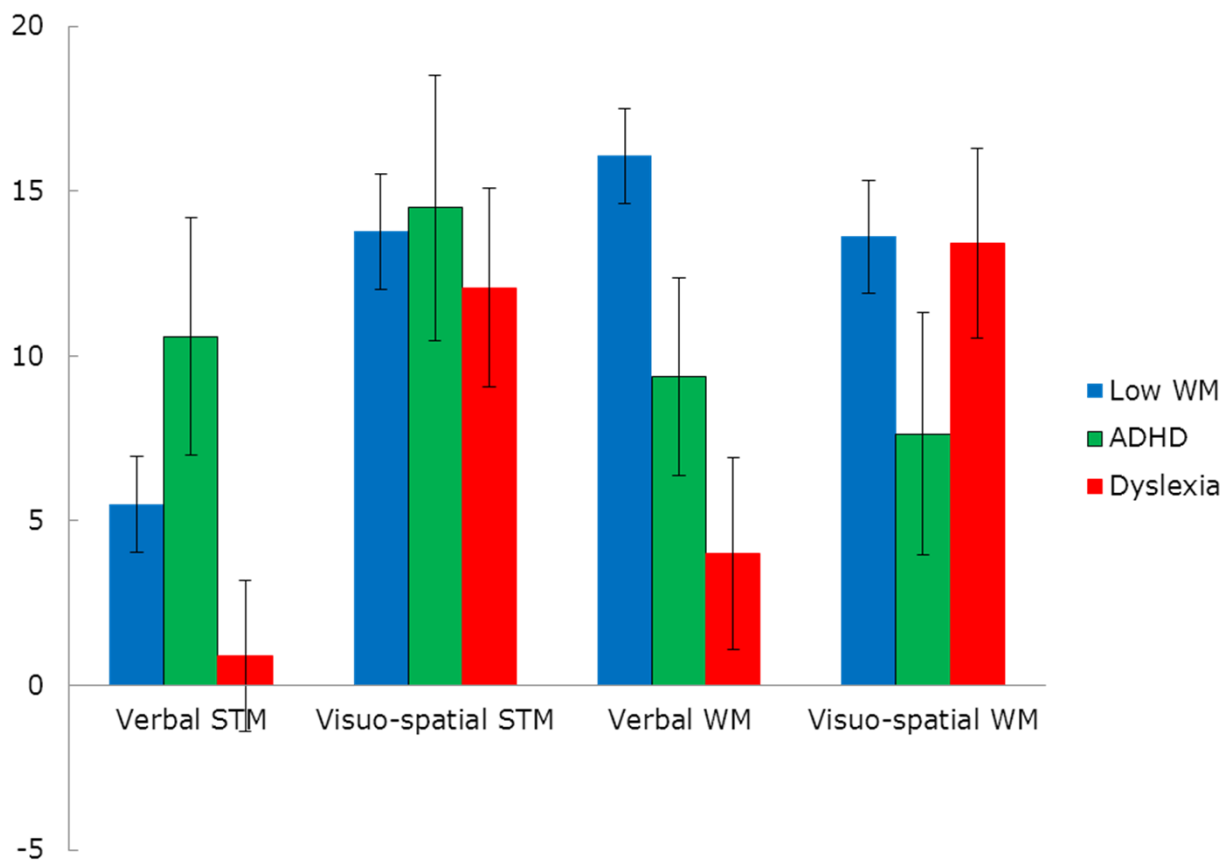
Generalised effects of working memory training

RCT with children with poor WM (Dunning, Holmes & Gathercole, 2013)

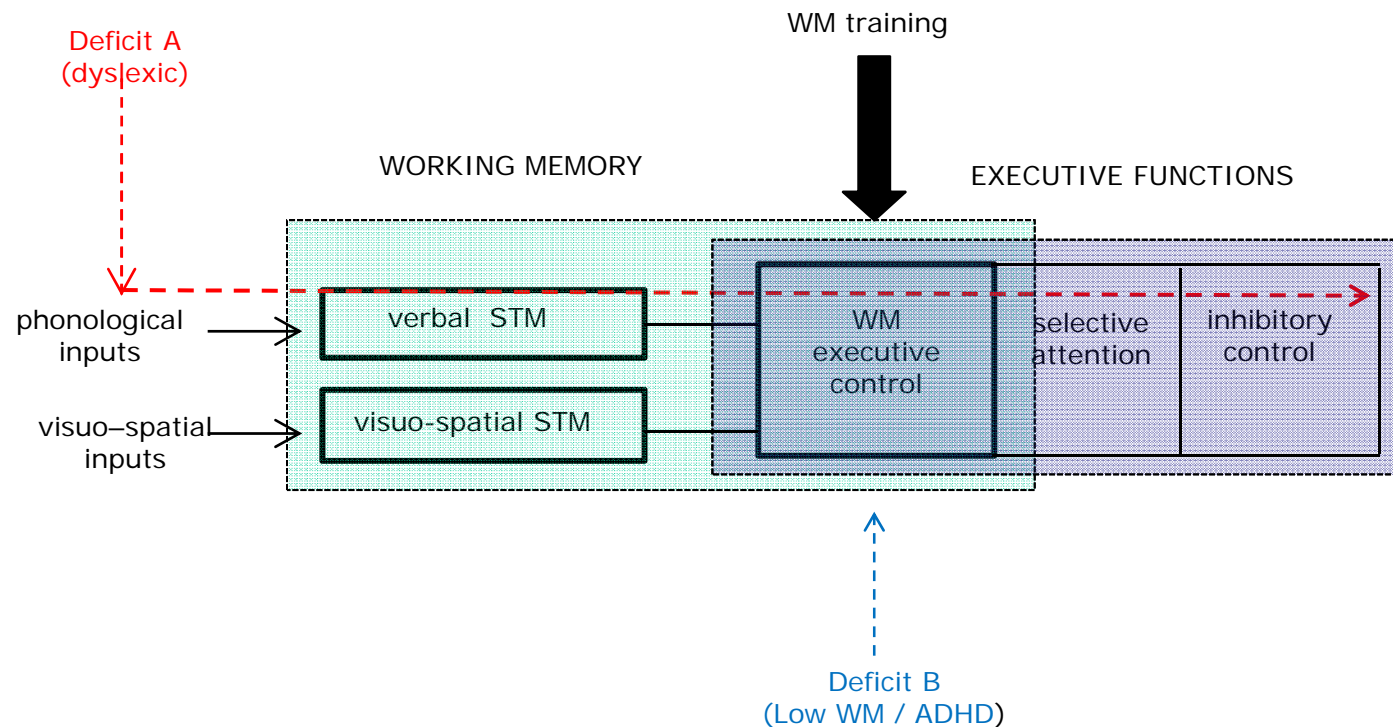


Cross-group comparisons

Preliminary evidence for different patterns of responsiveness to training



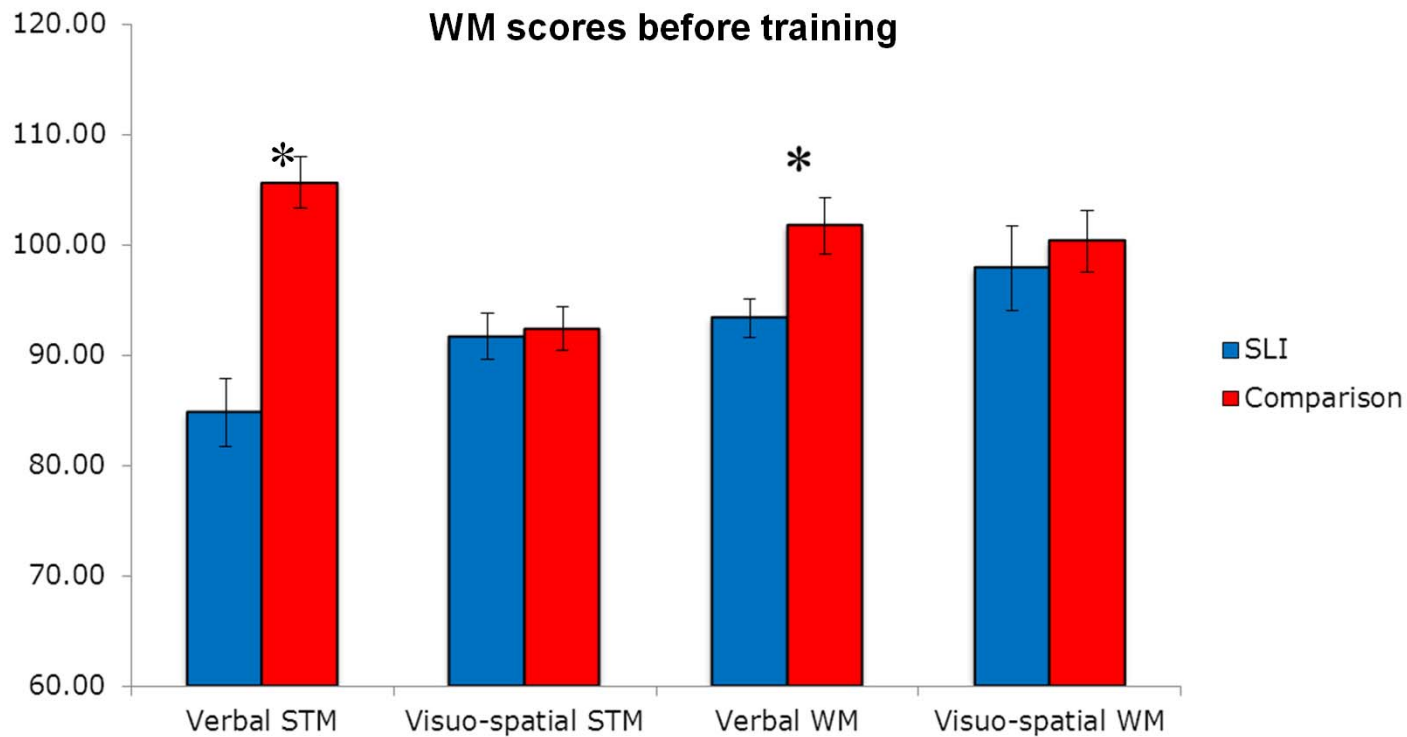
Where is the core deficit? Does it predict response to intervention?



- Children with SLI, using AWMA and Working Memory Diagnostic Instrument (WMDI)

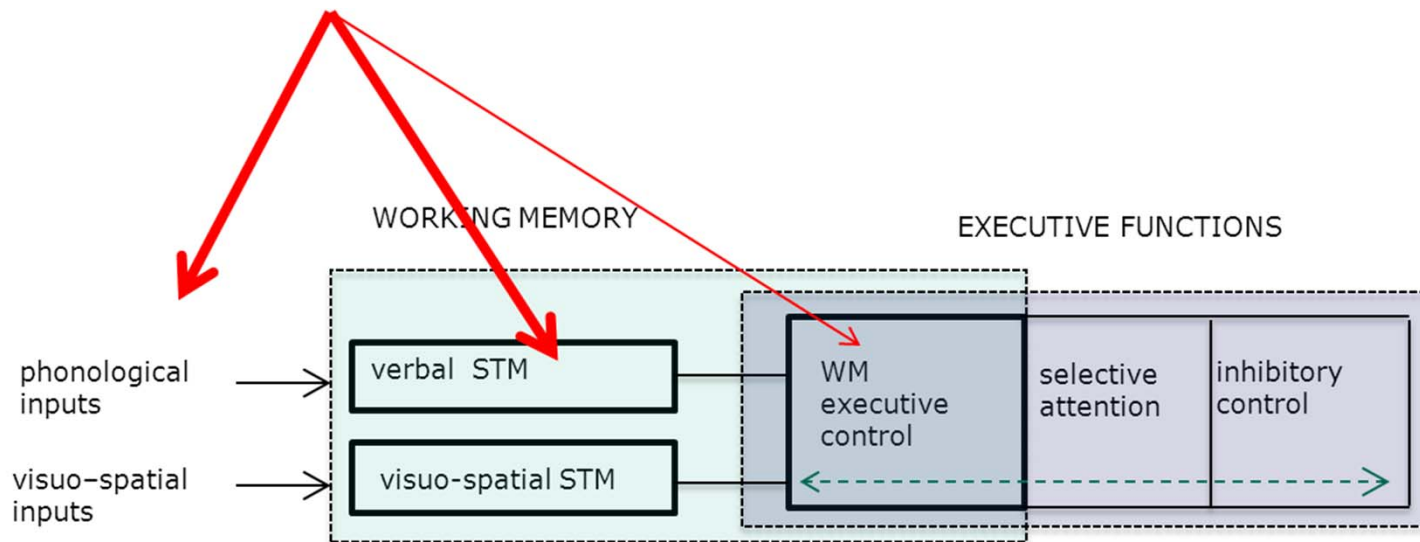
Children with Specific Language Impairments

- 14 SLI profile (expressive and receptive language difficulties)
- 15 age, gender and NVIQ matches



Children with Specific Language Impairments

WMDI profile before training



Training-related changes in WM scores

WM	Measure	SLI	Comparison
Verbal STM	Digit Recall	105.31	101.48
	Word Recall	91.07	103.9
	Composite	98.71	100.49
VS STM	Dot Matrix	106.06	109.87
	Block Recall	103.91	102.52
	Composite	104.98	106.20
Verbal WM	Listening Recall	97.06	104.79
	Backward Digit Recall	95.84	108.38
	Composite	95.47	105.54
VS WM	Mr X	98.31	102.91
	Spatial Recall	101.68	108.46
	Composite	100.00	105.69

Preliminary evidence that cognitive difficulty outside WM may limit response to WM intervention

Summary

- Working memory supports learning
- Deficits are common in many developmental disorders (and occur independently)
- WM impairment might not be a core deficit
 - could be a secondary consequence of a difficulty elsewhere
- Cause of WM difficulty limits response to intervention
 - WM training generalised improvements in ADHD & low WM groups
 - BUT constrains response in verbal aspects of WM in children with language problems
- Inform choice about intervention