



Attention, memory and learning and acquired learning difficulties

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Attention & learning: an information processing model

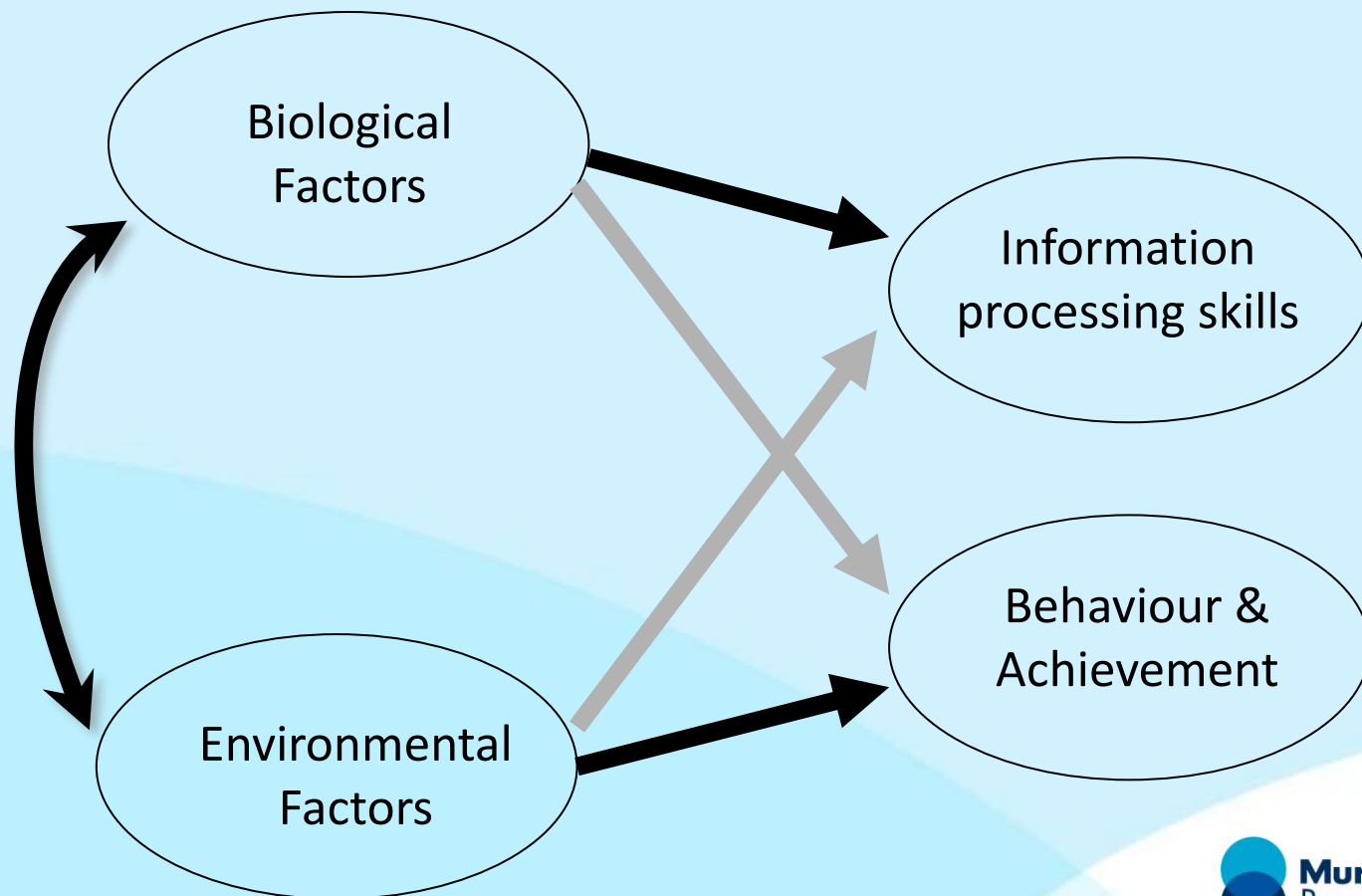
- information processing: the ability to attend to, register, encode, store and process information from the environment, and to output a response in a timely manner

Information processing impairments:

Potential causes

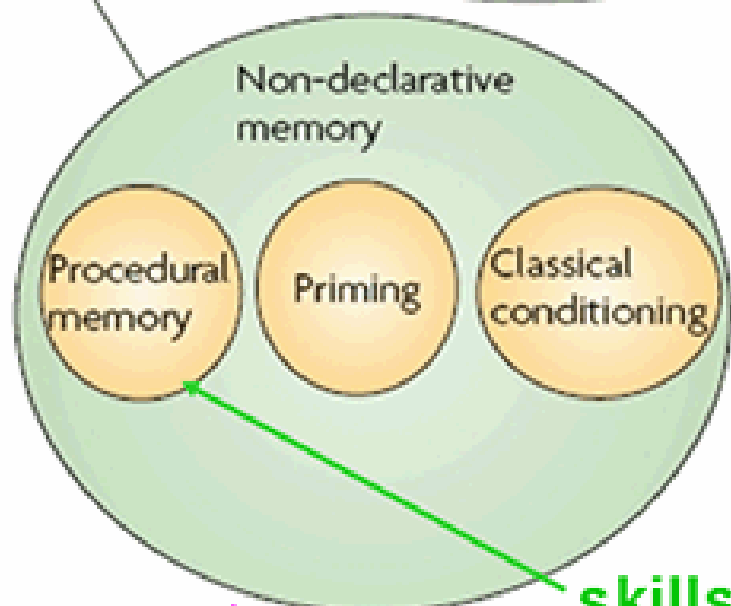
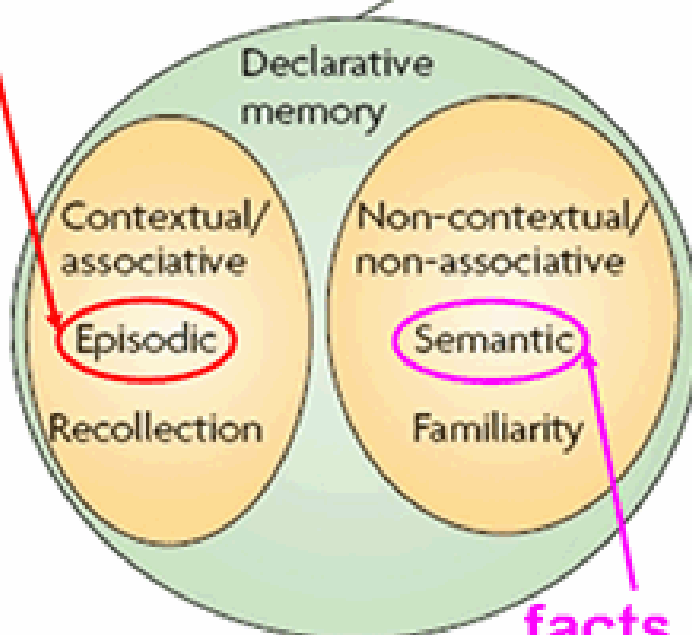
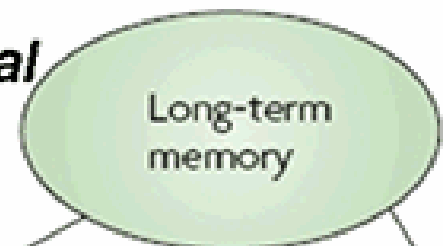
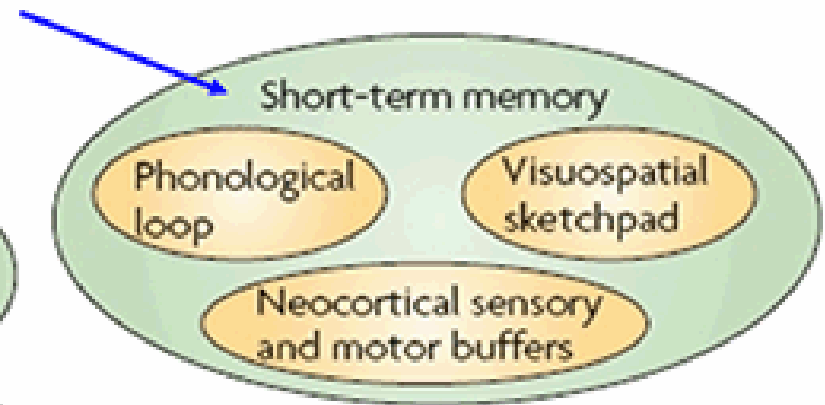
- developmental disorders
 - e.g. ADHD, learning disability
- acquired brain insults
 - e.g. head injury, epilepsy, tumour, prematurity
 - e.g. PKU, Turner's syndrome
- environmental factors
- psychiatric disturbance
 - e.g. depression, anxiety disorder, PTSD, psychosis

Conceptual model for influences on information processing



**personal past
experiences:
autobiographical
or episodic
memory**

phone numbers



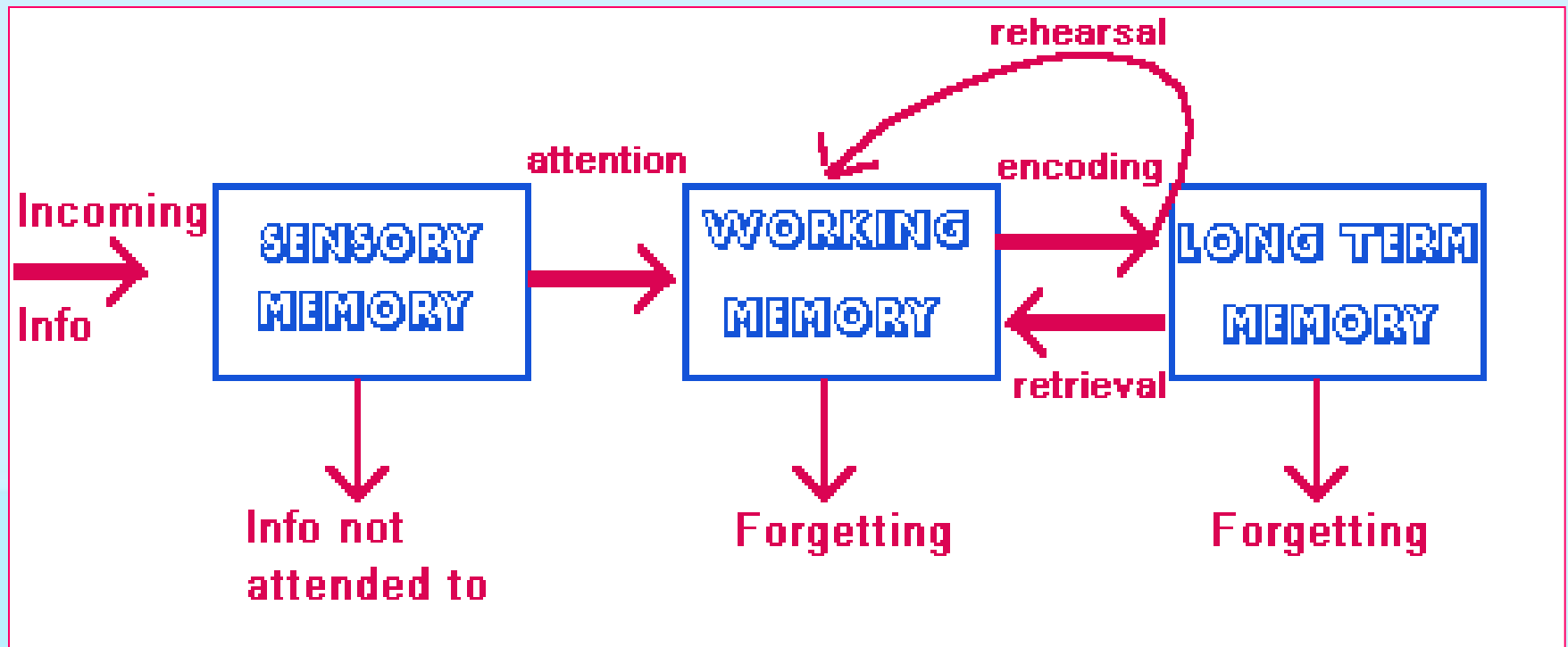
**facts, concepts,
vocabulary**

**skills, riding
a bicycle**

Outline

- **Memory and learning models**
- Development of information processing skills
- Disrupted memory and learning
- Examples
- Conclusions

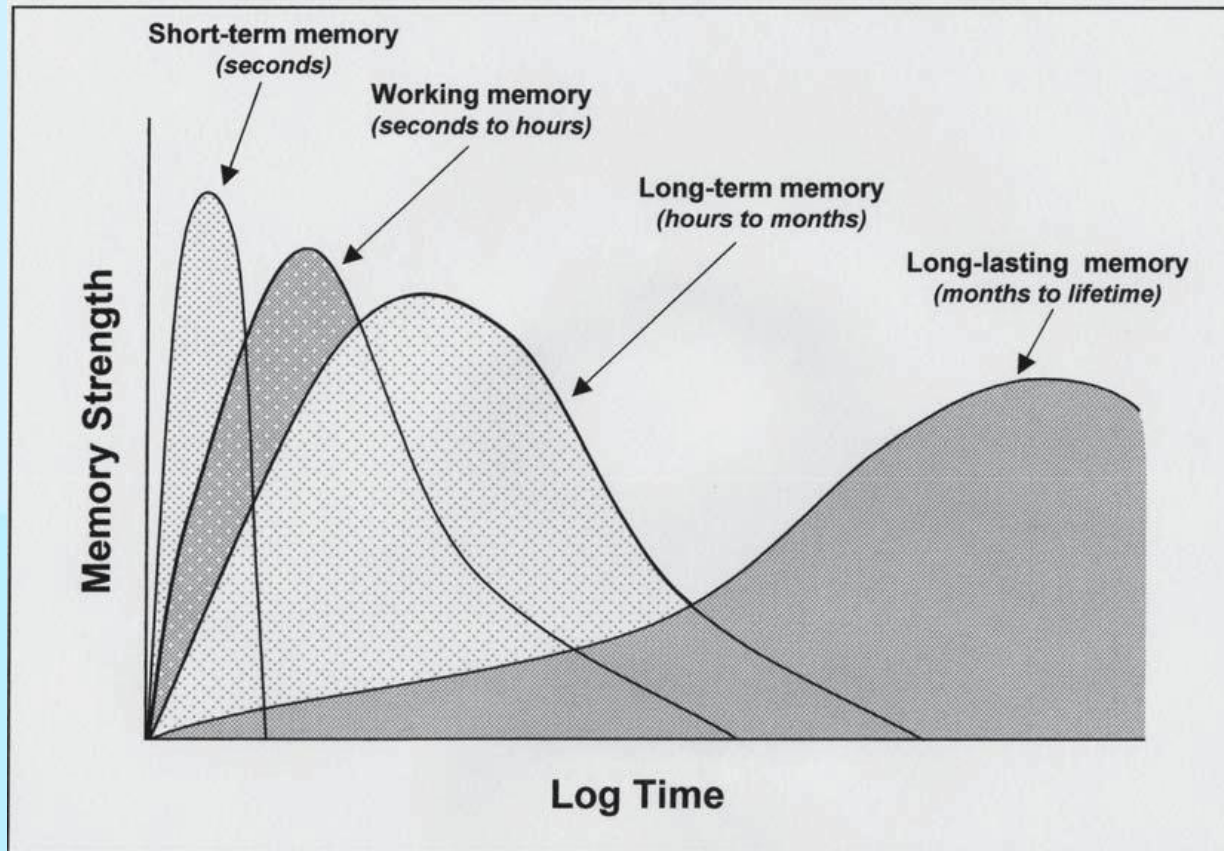
Memory and learning models



Specific language & learning difficulties

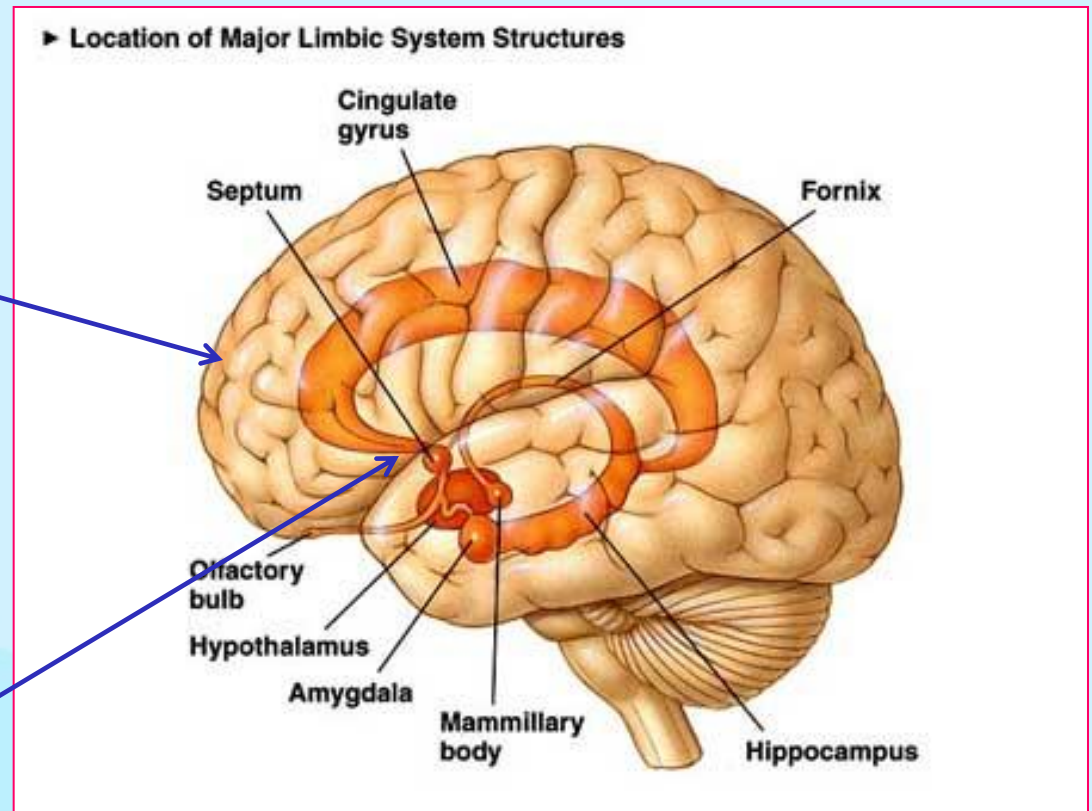
Not usually found in children

Memory – temporal course



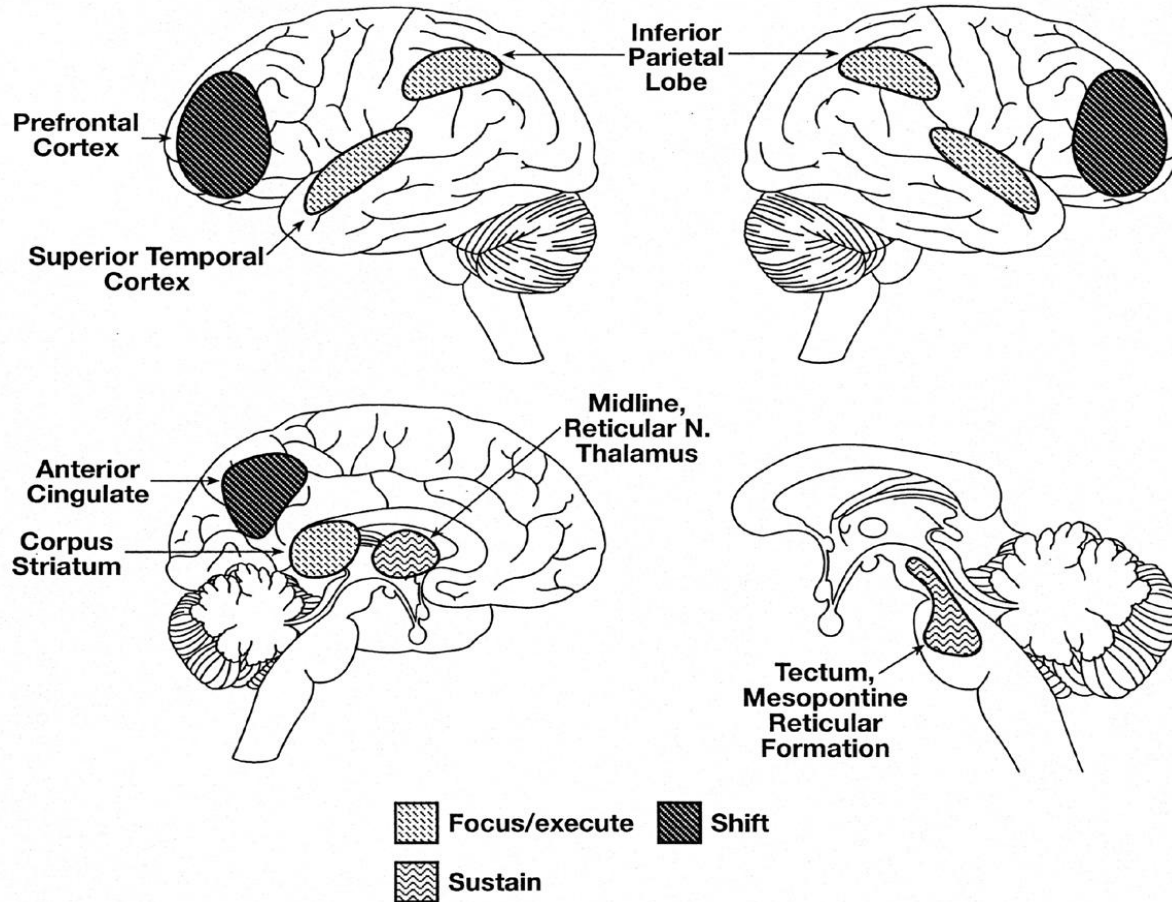
The memory system

Memory strategies/
working memory
(frontal regions)



Encoding and storage
Medial temporal regions)

Attention network



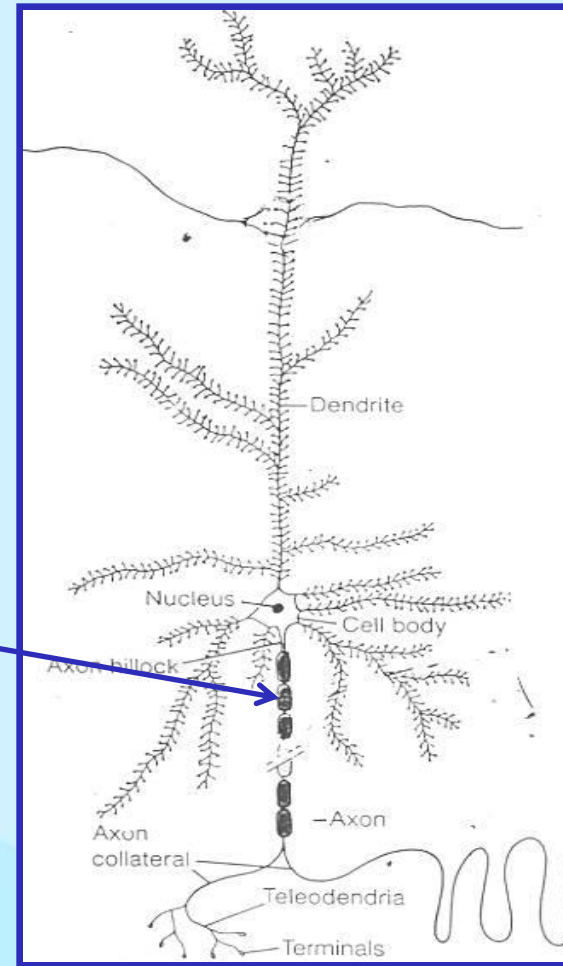
Processing speed/capacity

White matter tracts

Myelination =

↓ processing speed

↑ capacity



Neuroanatomy of memory and learning: The information processing system

- **attention:** brain stem, posterior cortex, prefrontal regions, white matter
- **memory and learning:** temporal and frontal regions
- **speed of processing:** white matter

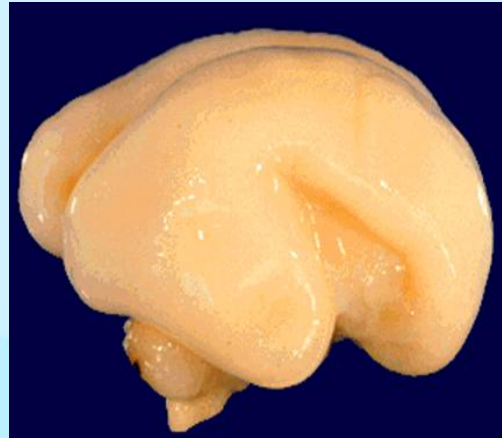
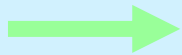
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- **Development of information processing skills**
- Disrupted memory and learning
- Examples
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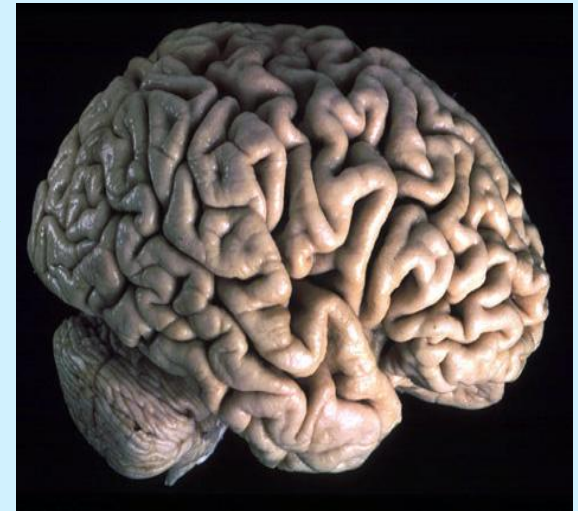
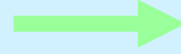
BRAIN DEVELOPMENT



3 weeks



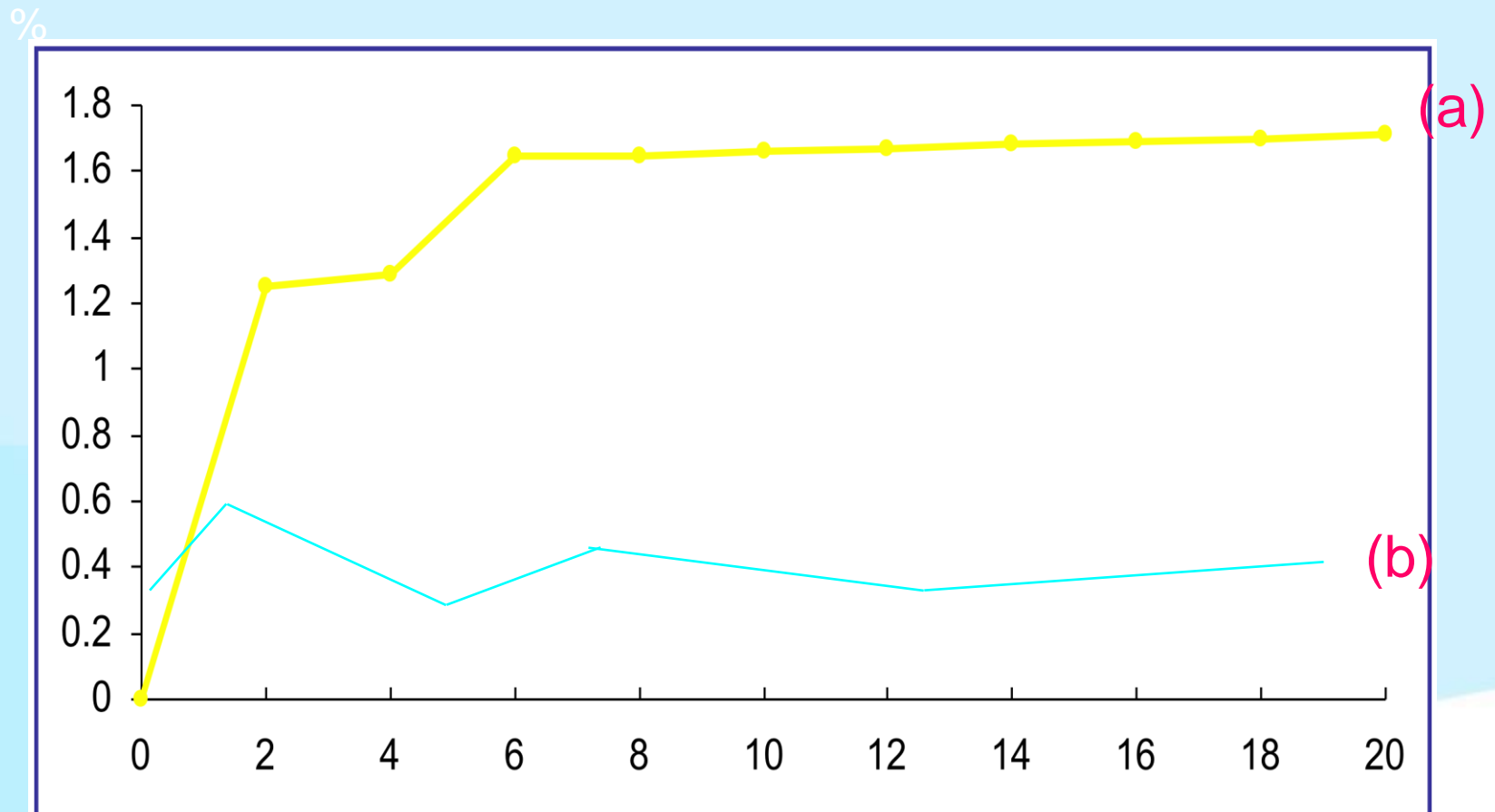
20 weeks



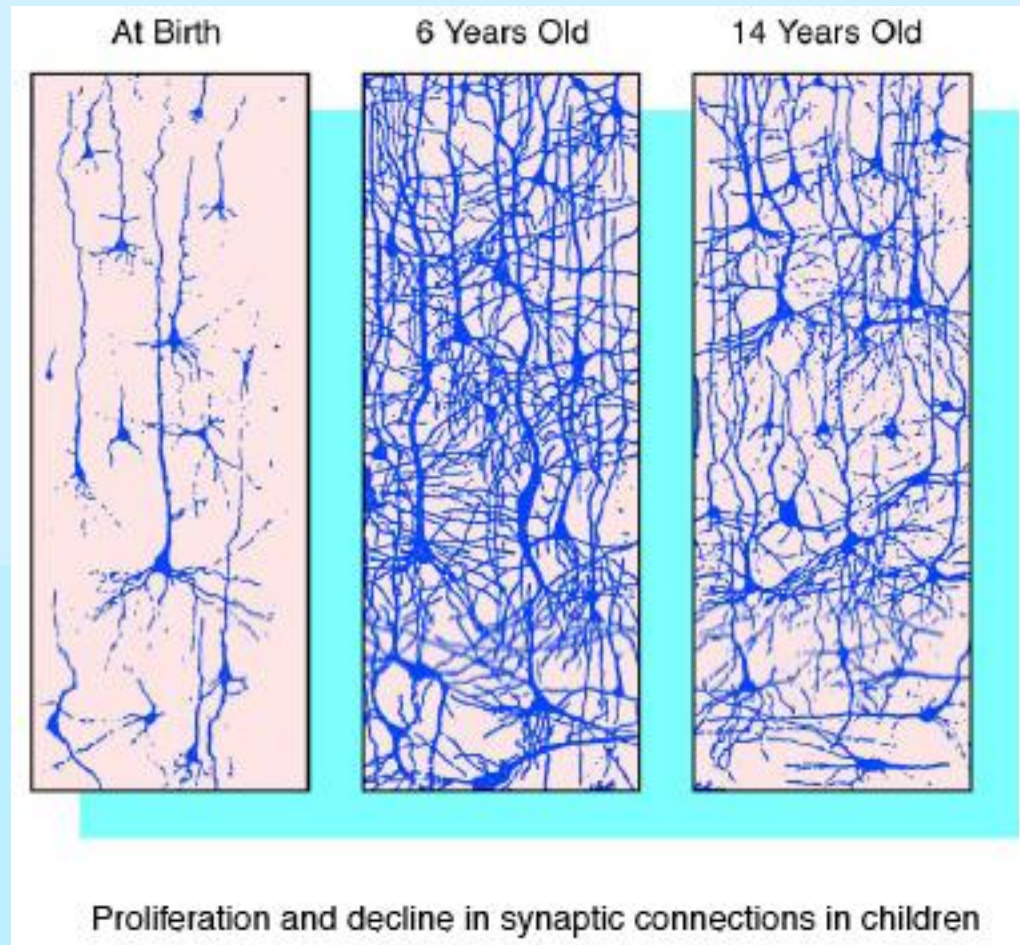
2 years

Increases in CNS brain weight

(a) Grey matter, (b) size of nerve cells in ontogeny



‘Connectivity’ –birth to puberty

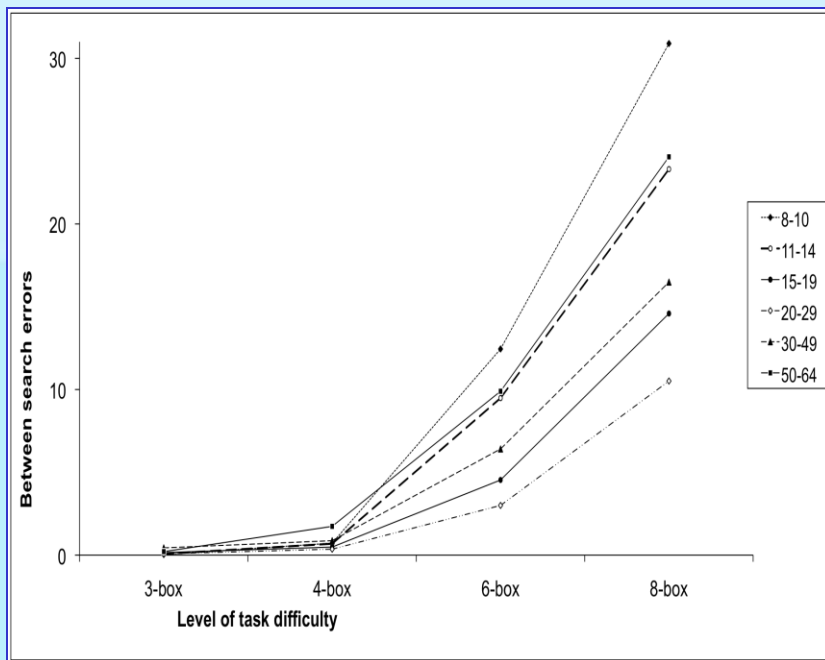


Developmental 'memory' milestones

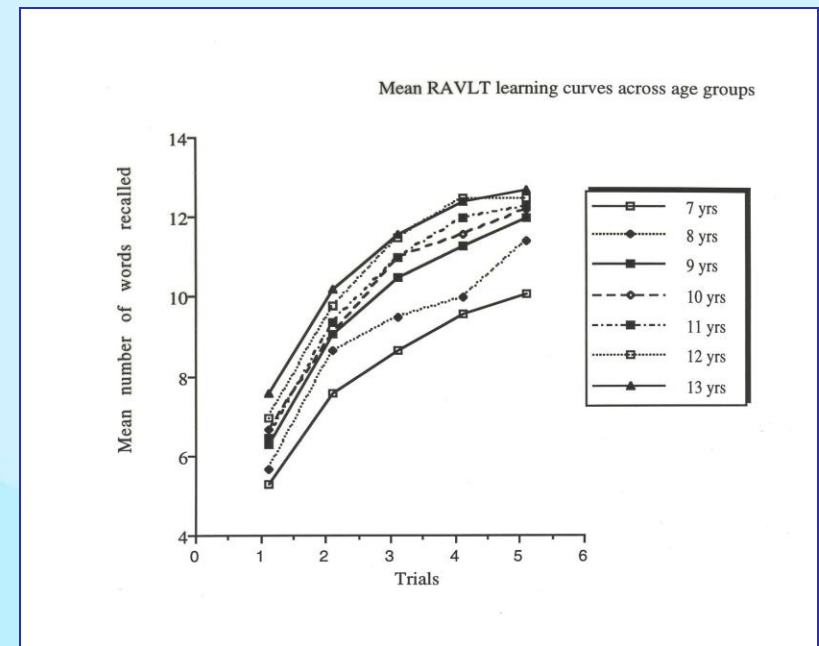
- Event memory – early childhood
- Memory span
- Processing speed and capacity
- Memory strategies (impacted by knowledge base and motivation/effort)
 - Rehearsal
 - organisation
 - elaboration
 - chunking

Development of memory and learning skills through childhood

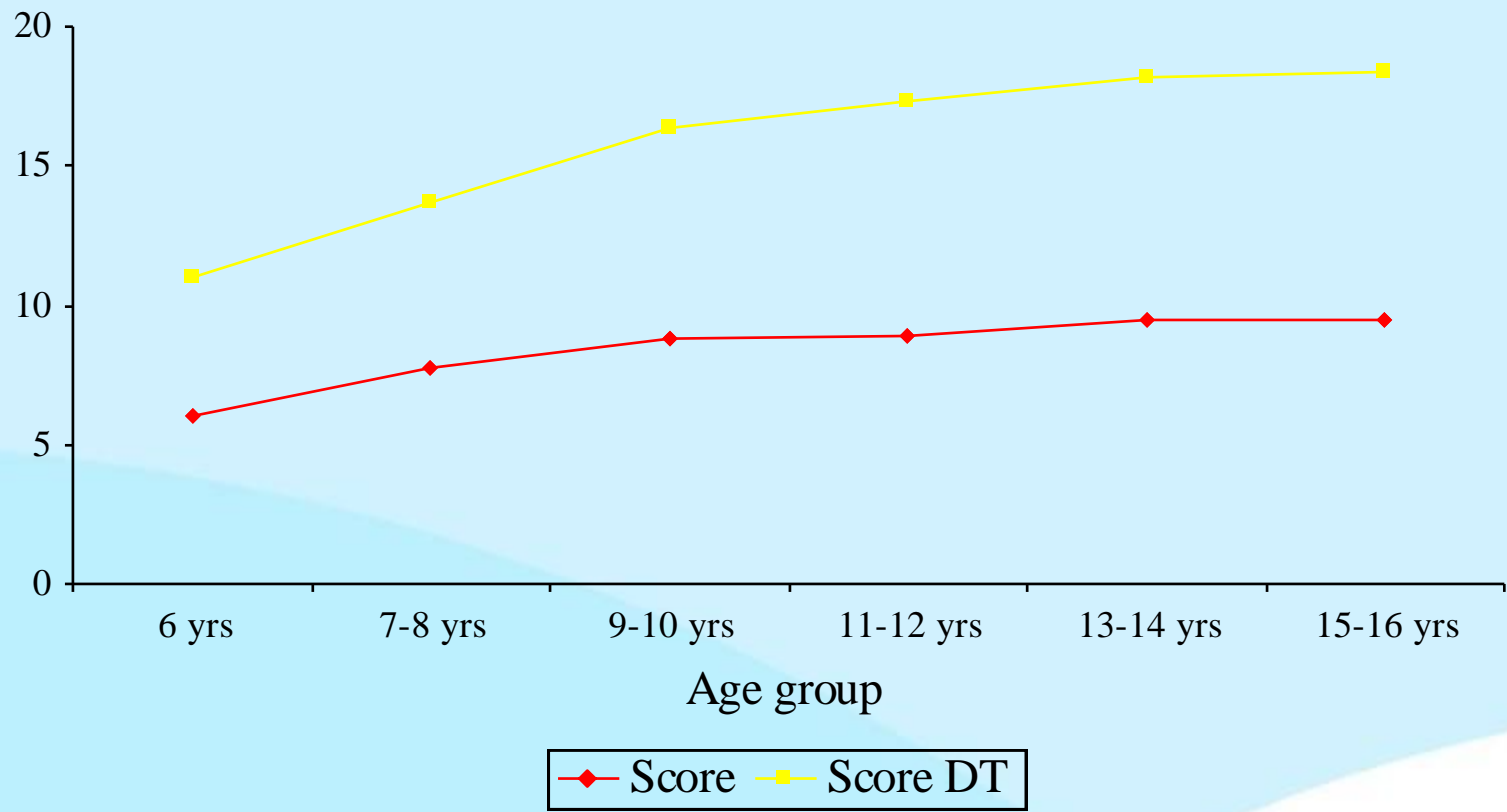
Spatial Working memory: errors



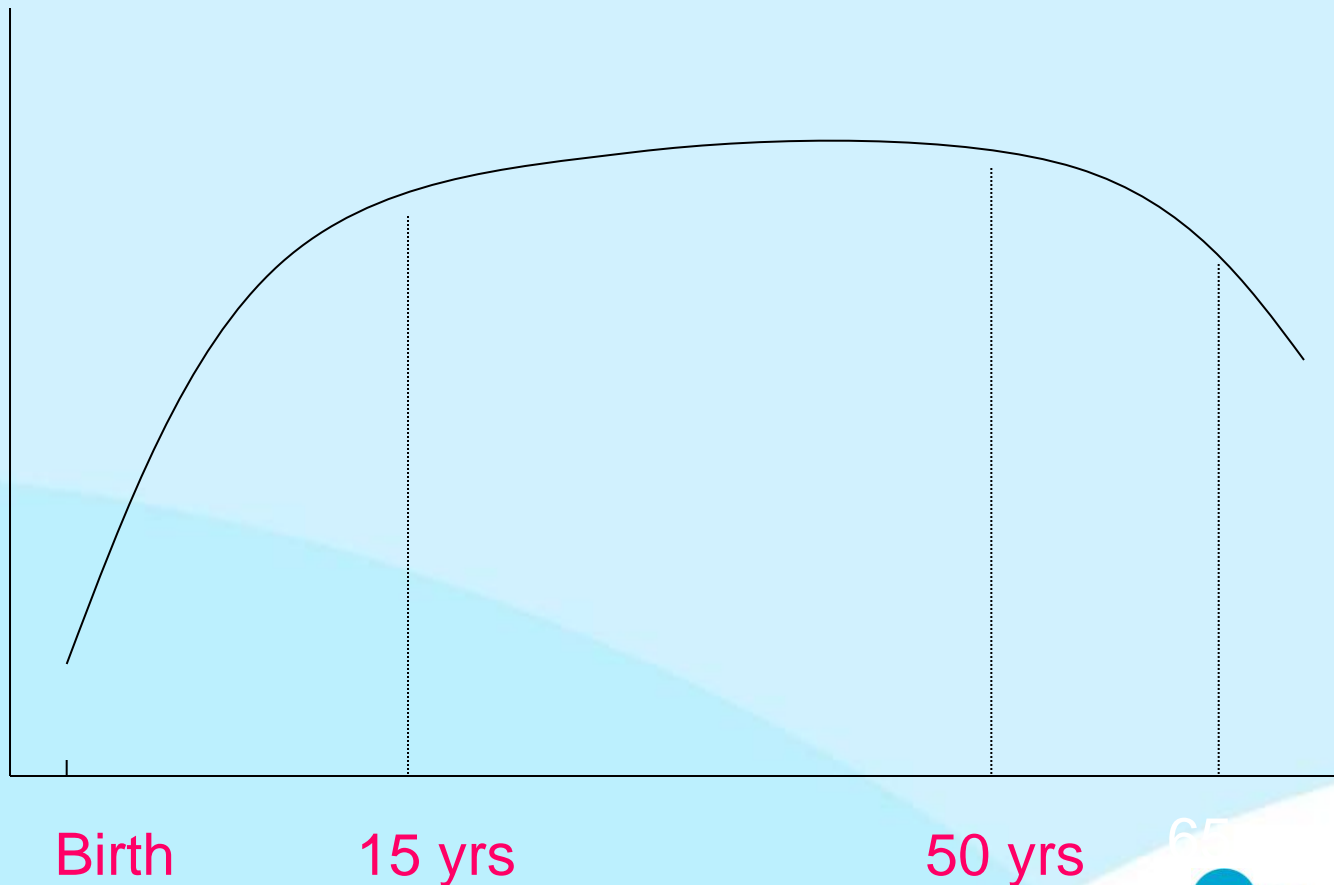
Word list learning - # correct



Development of attention



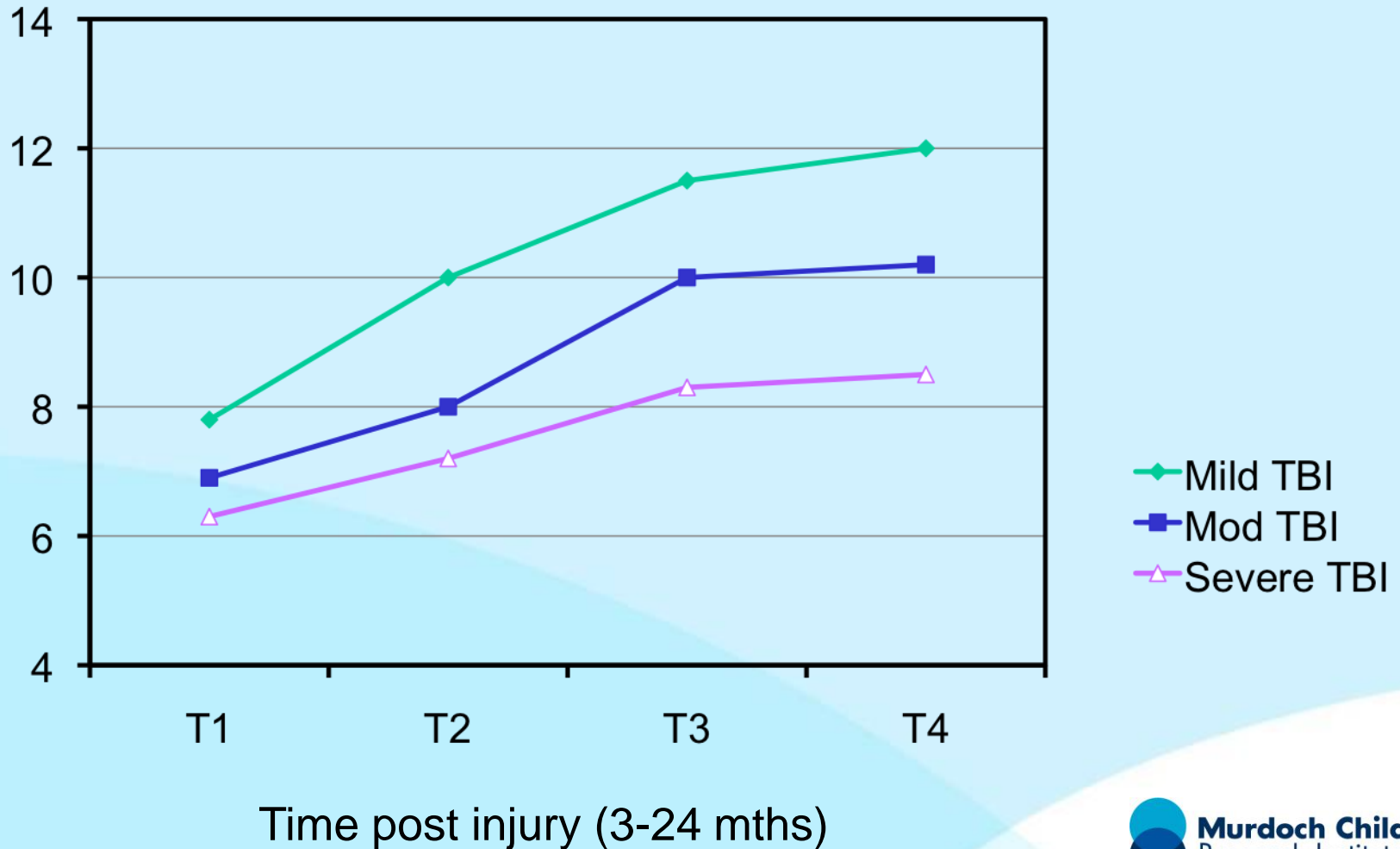
Development of memory and learning through life



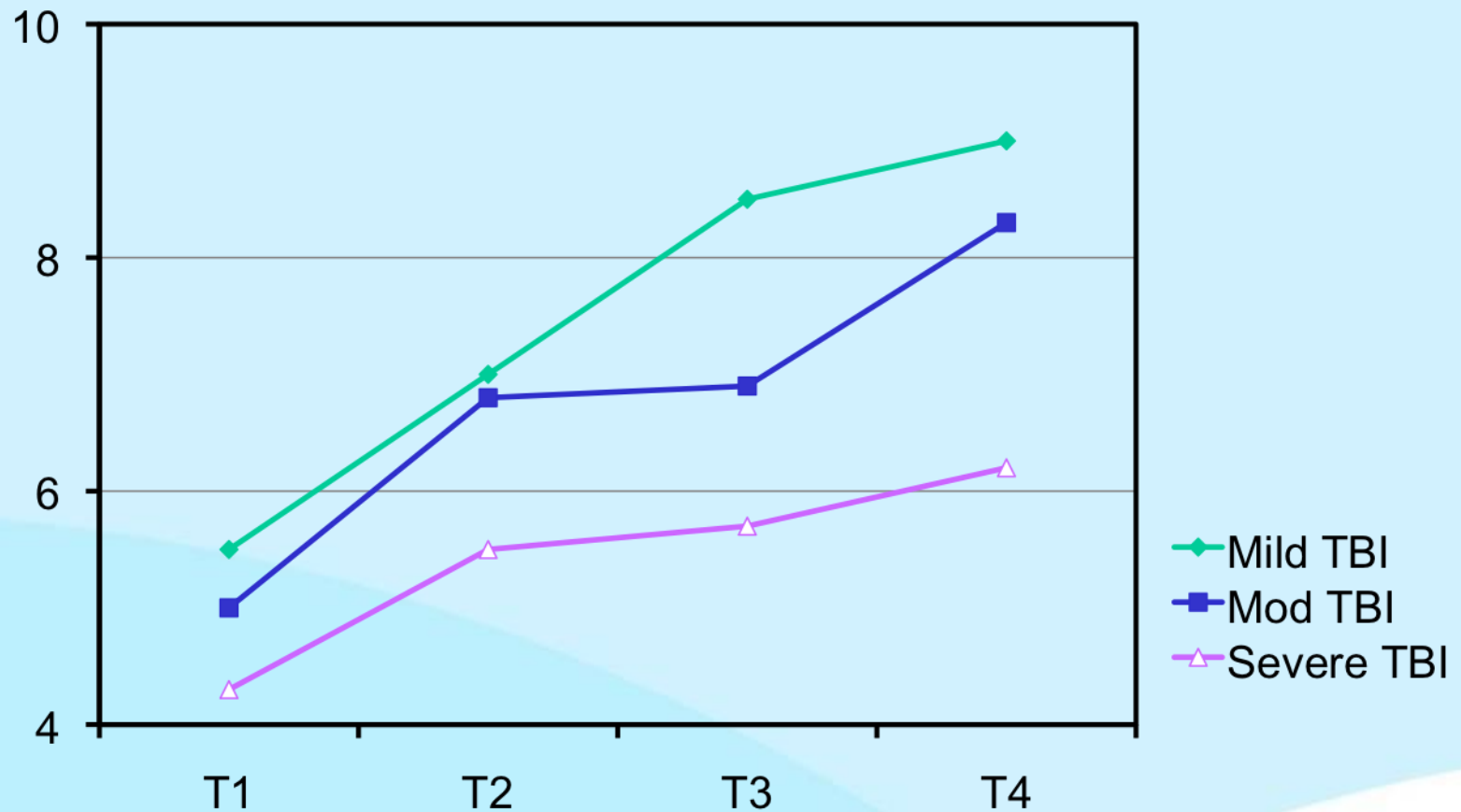
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- Development of information processing skills
- **Disrupted memory and learning**
- Examples
- Conclusions

Word list learning post child TBI

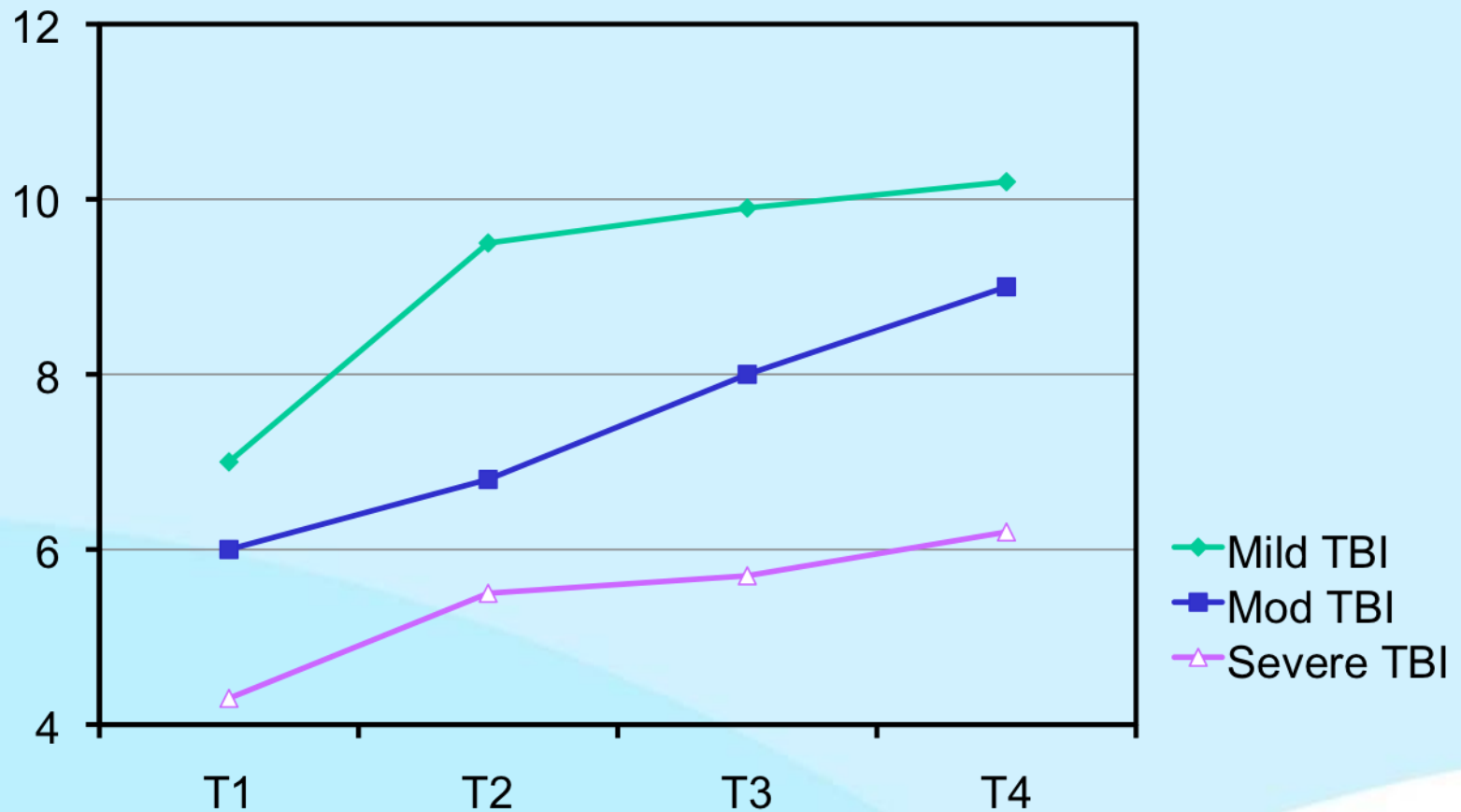


Picture learning post child TBI



Time post injury (3-24 mths)

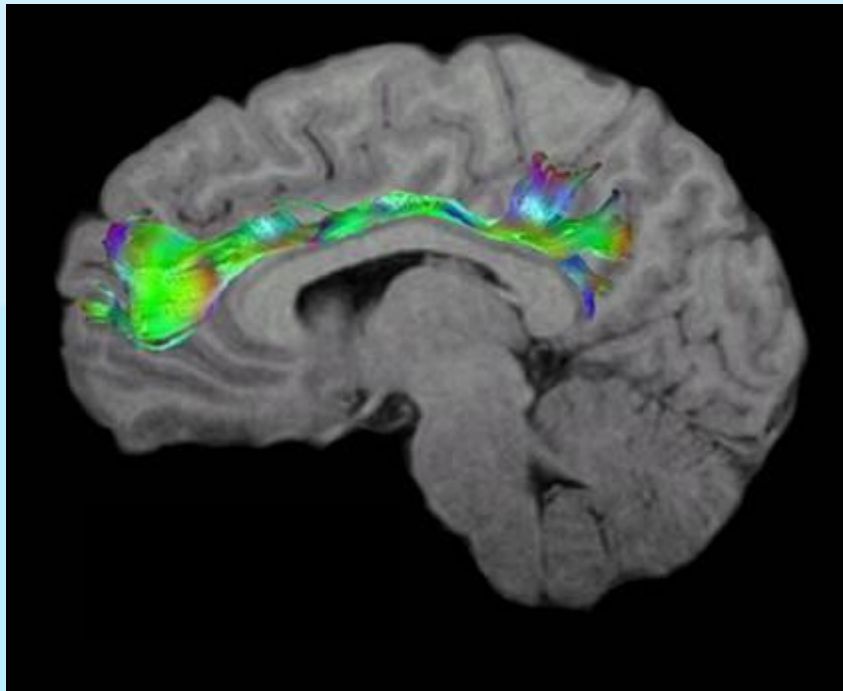
Processing speed post child TBI



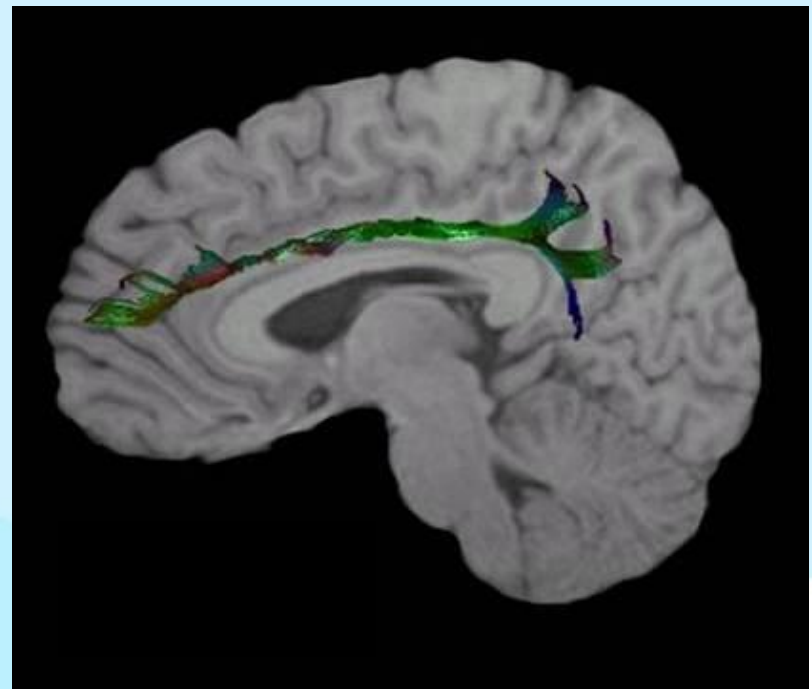
Time post injury (3-24 mths)

Severity of insult effects

Mild injury (13 year old)

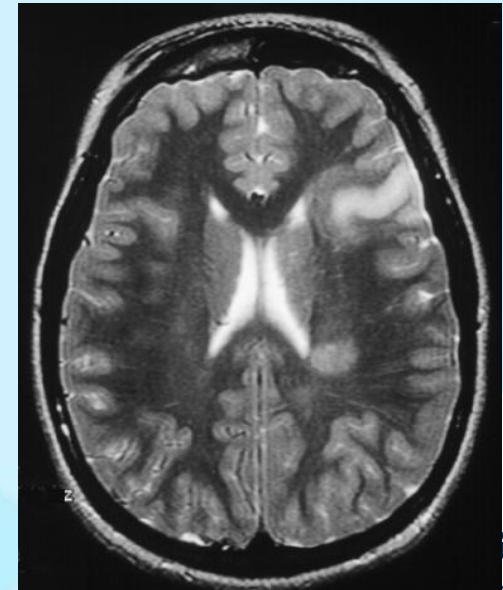
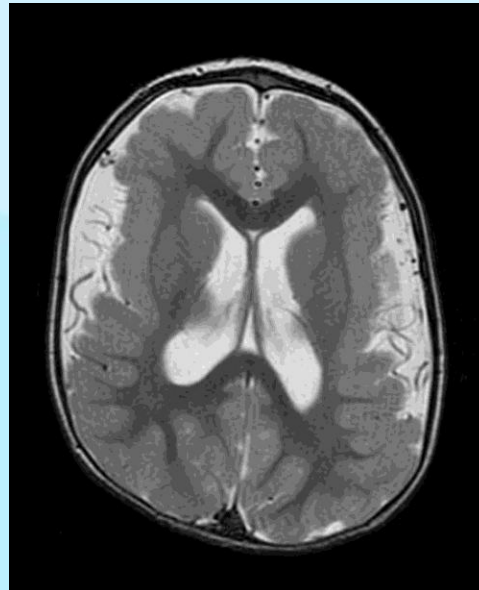
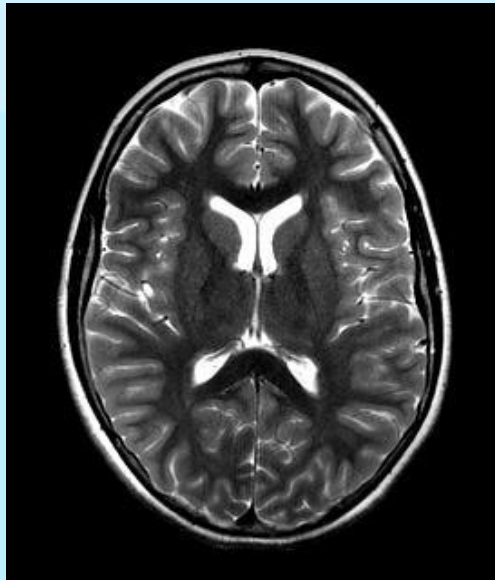


Severe injury (13 year old)

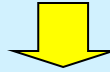


Age at insult effects

Normal brain



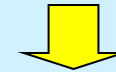
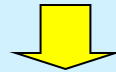
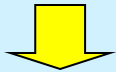
CNS injury/insult



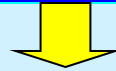
Primary Brain
Damage/Dysfunction
e.g. contusion, ischemia

Neuropsychological
Impairment
e.g. memory deficit

Psychosocial
Disturbance
e.g. less peer contact



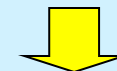
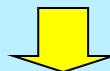
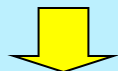
Ongoing Influence on Development



Abnormal Brain
Development
e.g. cerebral
atrophy

Neuropsychological
Impairment
e.g. limited memory
and learning

Psychosocial
Disturbance
e.g. inappropriate
social skills



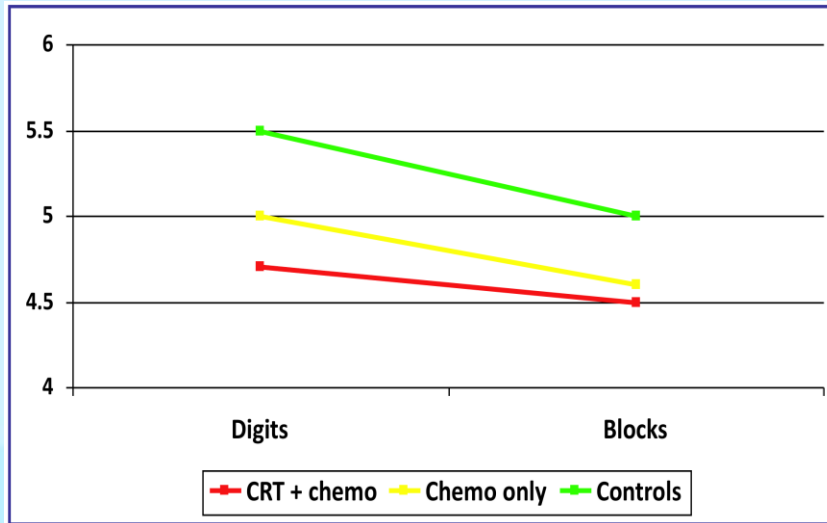
Generalized CNS, Memory & Social Impairment



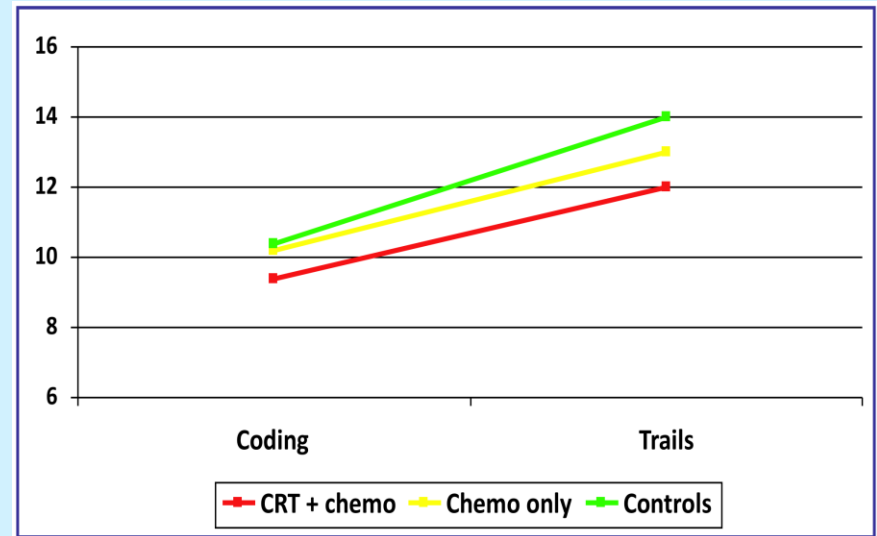
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**Do memory and learning problems
underpin educational problems
following childhood cancers?**

Processing capacity

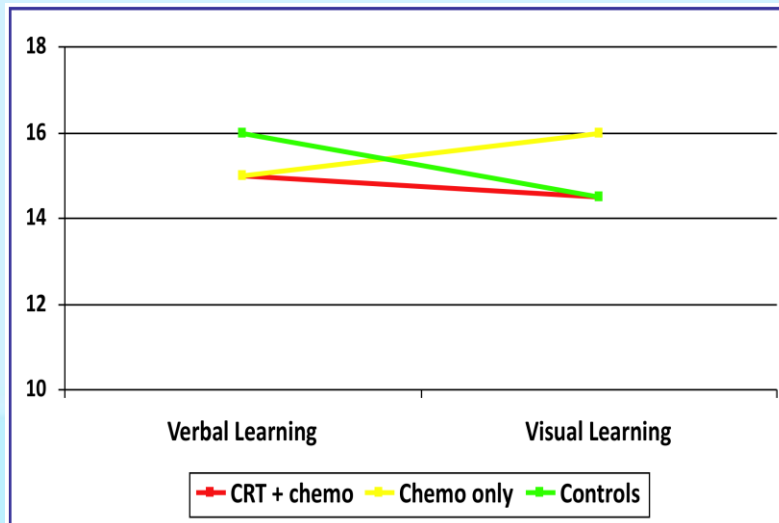


Processing speed

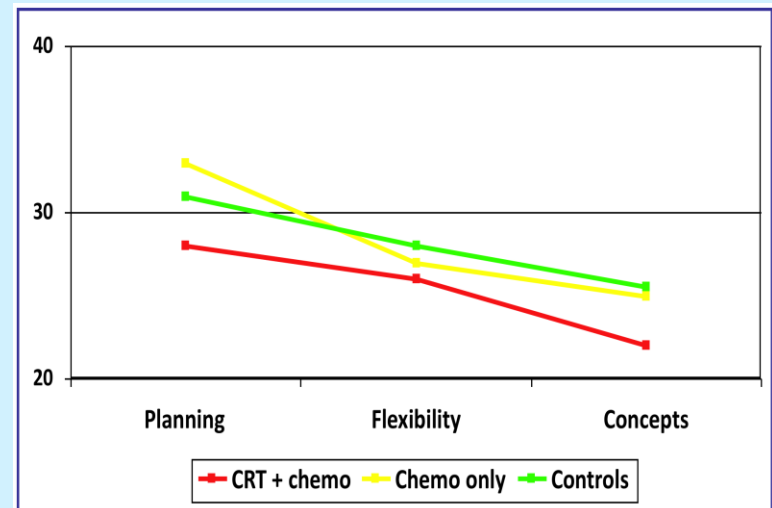


Children treated with radiation + chemotherapy demonstrated significant weaknesses

Memory and learning

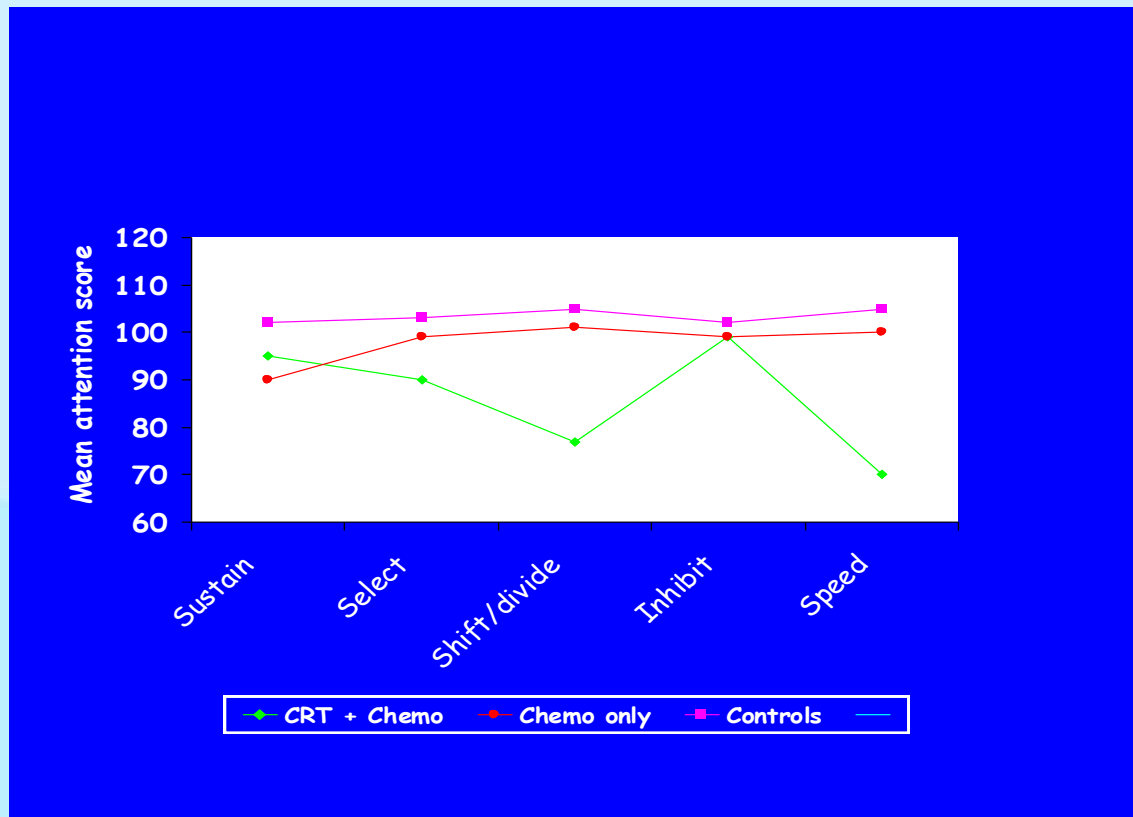


Executive functions



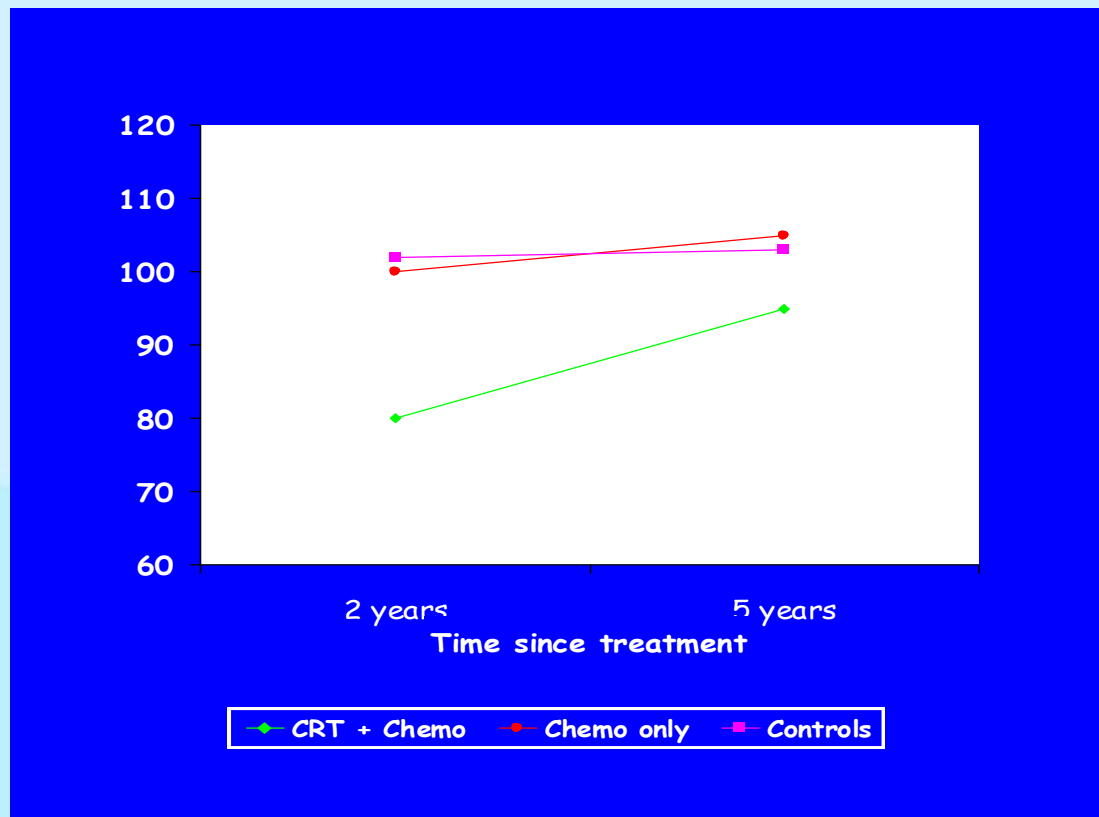
***No group differences for memory, learning
or executive skills***

Processing capacity and speed: predictors of educational problems?



(Anderson et al, J. Clin & Exp Neuropsych, 2004)

Reading outcomes following 'information processing' intervention



(Anderson et al, Brit J Cancer, 2000)

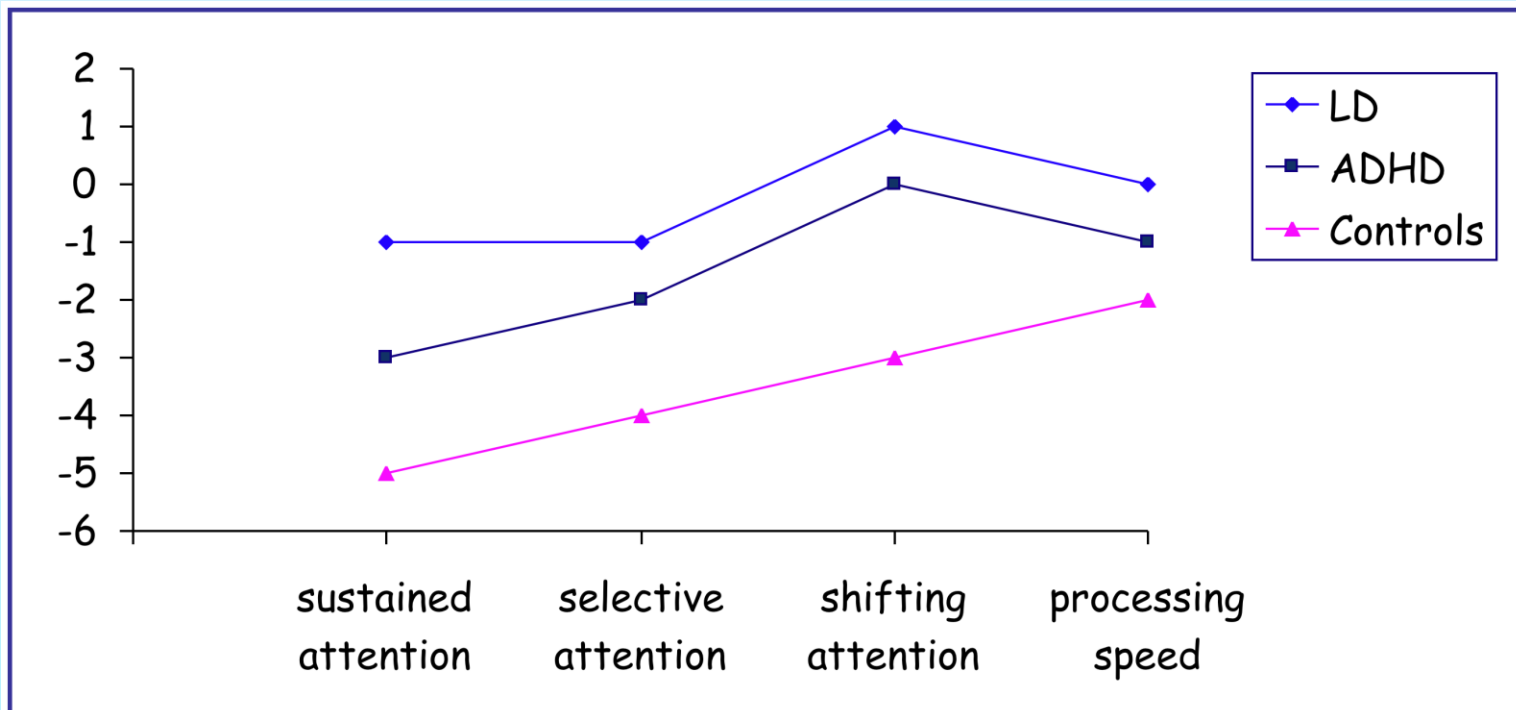
**Memory deficits are not always
what they seem:**

**Attention deficit/hyperactivity
disorder**

Clinical symptoms of ADHD

- can't concentrate
- Forgets instructions
- easily distracted
- day dreams
- restless, fidgety
- can't work independently
- disorganised
- can't finish tasks
- acts before thinking
- impulsive

Standardised factor scores on components of information processing



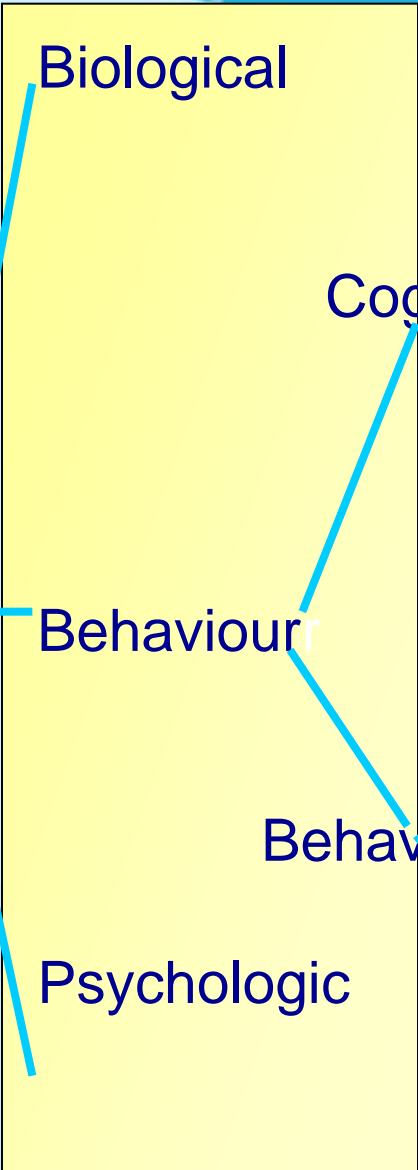
LD is associated with greater information processing problems than ADHD

Summary of deficient abilities: ADHD & LD

	ADHD	LD	ADHD +LD	ADHD + CD
Sustained att.	-	--	--	*
Selective att.	-	--	--	*
Impulsivity	-	*	-	--
Response speed	*	--	--	*
Memory/learning	*	-	--	*

** normal, - mild impairment, --severe impairment*

ATTENTION



ADD/LD

Cognitive

Inattention

ADD

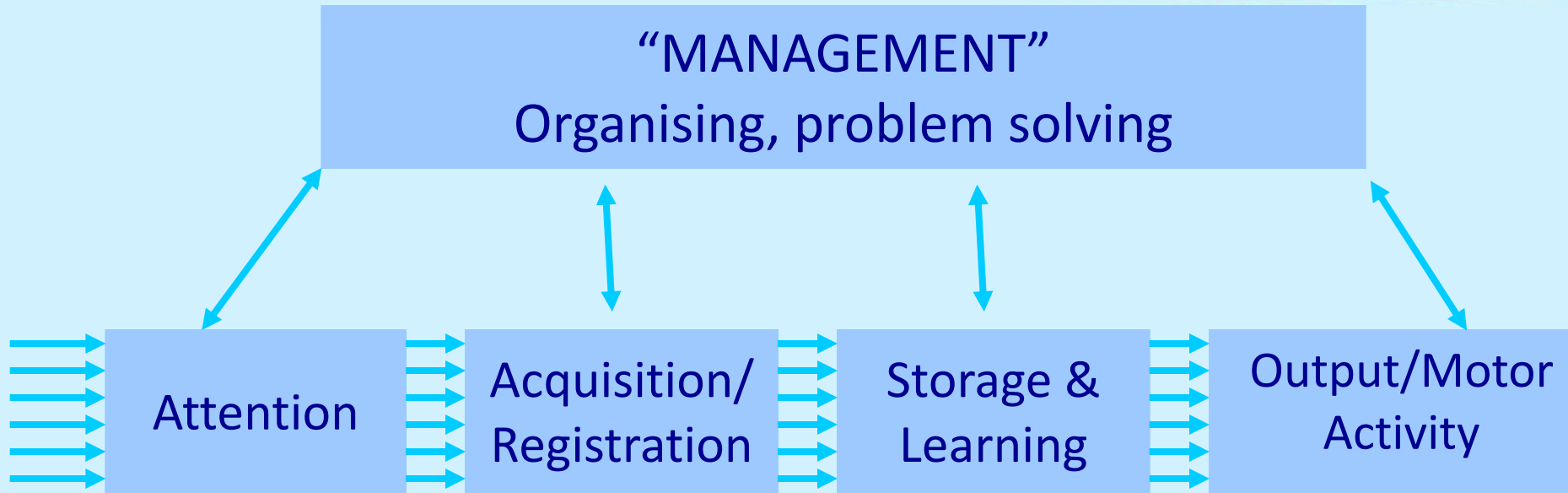
Behavioural

Hyperactivity/
Impulsivitiy

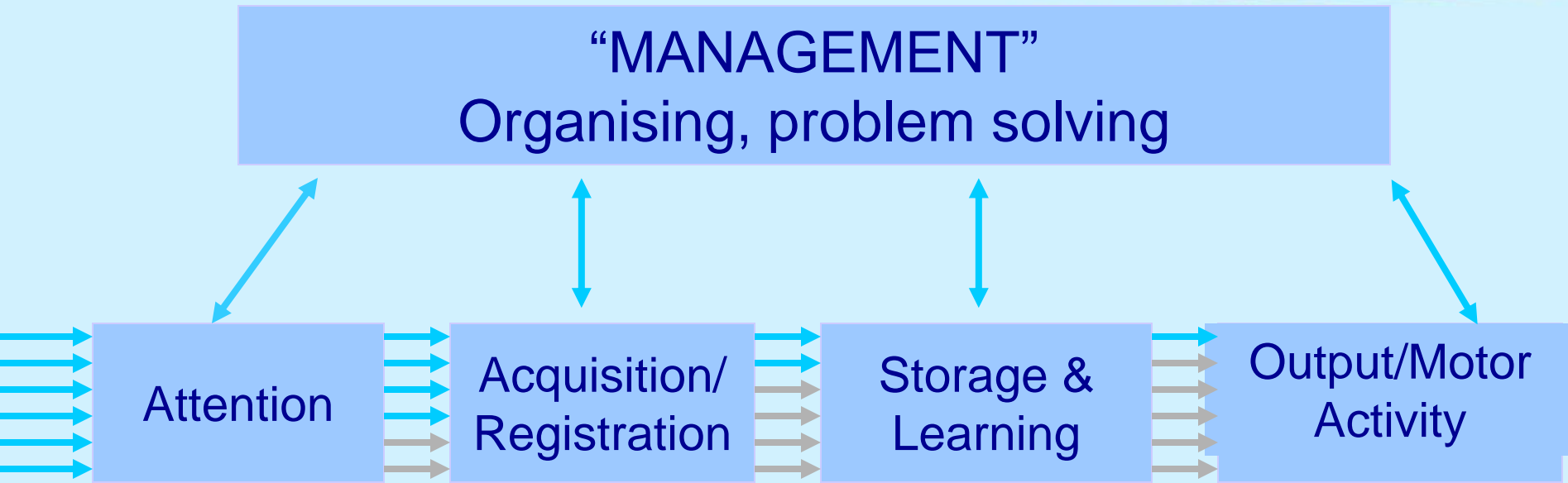
ADD/ODD/CD

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- Memory and learning models
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- **Examples**
- Conclusions



The Information Processing System



Impaired Information Processing System

Impaired attention: Warren

- Referral: paediatrician, ??? ADHD
- History: no medical/developmental problems
- Educational progress: poor
- Extremely disruptive, unco-operative in class
- Behaviour: over-active, restless, impulsive, aggressive behaviour

Summary of cognitive function

	8 yrs	11 yrs
IQ	superior	superior
Educational skills	v. poor	average
Sustained attention	v. poor	average
Memory/learning	v. poor	average
Organisational skills	v. poor	superior
Attention capacity	poor	average
Processing speed	poor	average
Mental flexibility	poor	average

** significant improvements*

Neuropsychological assessment

A. IQ

	8yr	11yr		8yr	11yr
Information	14	14	Picture Comp.	12	13
Similarities	12	13	Picture Arr.	15	14
Arithmetic	7	9	Block Design	15	15
Vocabulary	12	13	Object Ass.	13	14
Comprehension	12	12	Coding	6	8
Digit Span	6	8			

Impaired acquisition/registration: Daniel

- Referral: learning difficulties
- History: no medical/developmental problems
- Educational progress: literacy poor, numeracy average
- Behaviour and social skills: NAD

Summary of cognitive function

IQ	high average
Educational skills	reading impaired, maths OK
Attention	average
Acquisition*	impaired
Memory/learning	average (with repetition or context)
Organisational skills	high average
Processing speed	low

- Early primary: Digits forwards poor
- Late primary: working memory difficulties more evident and Daniel displayed good use of strategies, but reading remained impaired

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Jamie M.

**A case of 'amnesia' following
appendectomy**

Presenting complaint

- Jamie is a 13 year old boy whose parents have observed severe memory problems, disturbed sleeping and eating patterns and aggressive behaviour following recent surgery for appendicitis
- Referral: paediatric neurologist

Clinical history

- 3 months prior to referral Jamie underwent appendectomy
- failed to recover from anaesthetic, with a period of hypoxia
- remained unconscious with respiratory support for 48 hours
- hospital records show family history of enzyme deficiency (pseudo-cholin estenase) associated with lack of response to antidote for reversing anaesthetic

Clinical history

- on recovery from anaesthetic Jamie was confused and disoriented, with poor coordination, and memory loss for recent events
- no further investigations were conducted and Jamie was discharged home
- no rehabilitation was considered necessary

Follow-up

- parents sought help from local and city hospital: diagnosis behavioural disorder
- recommendation: clearer structure at home
- worsening problems over next three months, including increasing aggression
- family member arranges neurological referral:
 - -EEG: abnormal activity, consistent with absence seizures
 - -MRI: NAD

Neuropsychological assessment

- Speed of processing: initially slow, but recovered
- Visuo-motor skills: residual moderate difficulties
- Language skills: generally intact
- Executive skills: generally intact

Memory data

	3mth	1 year	3y 6mth
Verbal Learn (SS) (2,4,4, 10, Del = 0)	6	4	4
Visual Learn (SS) (1,1,6,3, Del =2)	4	3	3
Story Recall (SS) (11, 3, Del 0,1)	5	-	-
Sentences (SS)	4	5	6

Long-term recovery

- memory problems largely unchanged
- very poor educational progress
 - *full time integration support*
 - *regular speech & occupational therapy*
- behavioural problems reduced, family coping
- social interactions OK
 - *individual and family counselling*

Impaired 'output': Lauren

- 16 year old girl in Year 11
- Referral: family, support for special consideration
- History: congenital heart disease, stroke at 2 years, Type 1 diabetes
- Educational progress: good through primary and early secondary school, but struggling in Years 11 and 12
- Struggles to complete tasks in allotted time
- Behaviour and social skills: NAD

Summary of cognitive function

IQ	high average
Educational skills	intact, but written work slow
Sustained attention	average
Memory/learning	average
Organisational skills	average
Attention capacity	average
Processing speed	very poor
Working memory	low

Neuropsychological assessment

A. IQ

Similarities	14	Block Design.	10
Vocabulary	13	Picture Concepts	11
Comprehension	32	Matrix Reasoning	8
Digit Span	11	Coding	6
Letter/No Seq	9	Symbol Search	6
(Arithmetic)	(7)		

Reduced 1) processing speed

2) working memory, but only evident on complex tasks

Testing for memory problems

- Capacity
 - digit span, block span, sentence repetition
- Processing speed
 - Coding, Symbol Search
- Attention
 - TEA-Ch
- Working memory
 - Digits backwards, Letter sequencing
- Memory strategies
 - Word list learning, Rey Figure

Conclusions

- Memory and learning skills are part of a complex, neural network or '**information processing**' system. Disruption to any aspect of the system may have significant consequences for the total system
- Skills within this **information processing system** develop rapidly through infancy and childhood along with the brain regions supporting them
- The **information processing system** is critical for intact learning within the educational context.

Conclusions

- Children with developmental or acquired conditions impacting on 'brain' are at high risk of **information processing** problems
- The most common problems are for:
 - Processing capacity
 - Processing speed
 - Working memory
- In children, long-term memory is rarely impaired

Conclusions

- It can be difficult to separate out these problems in everyday contexts
- Accurate description and diagnosis is important for appropriate interventions
- Interventions need to take into account
 - Age/developmental stage of the child
 - The child's learning context
 - Development of realistic goals for success