

# Memory disorders in children with epilepsy: types, evaluation and treatment.

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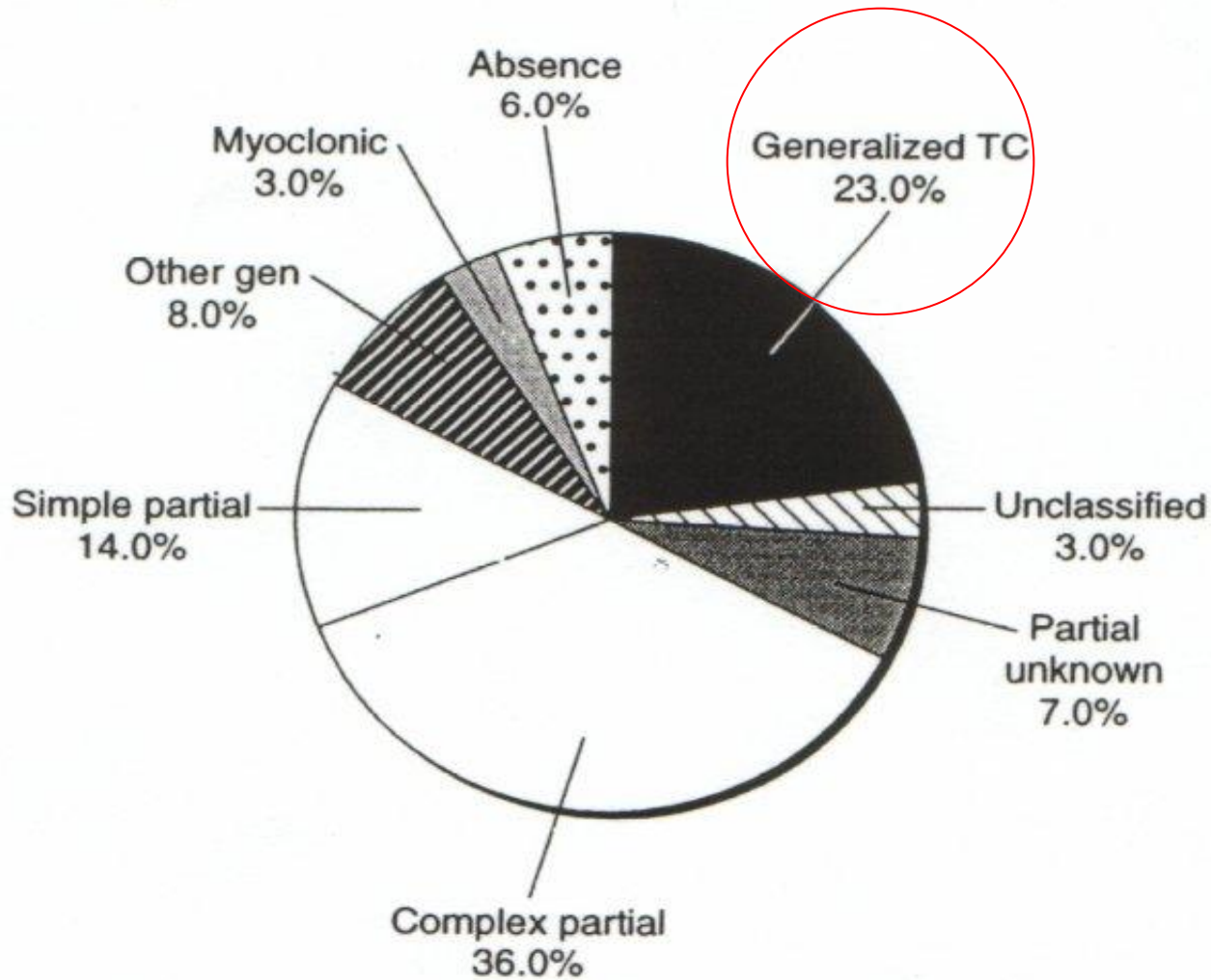
- General information about epilepsy
  - Types of memory disorders encountered by children with epilepsy.
  - Neuropsychological assessment of memory
  - Case study
  - Study: dissociation between semantic and episodic memory
  - Interventions
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# What is epilepsy?

“Epilepsy is any one of a group of disorders of brain function characterised by recurrent attacks that have sudden onset.”

Oxford Medical Dictionary, 1990

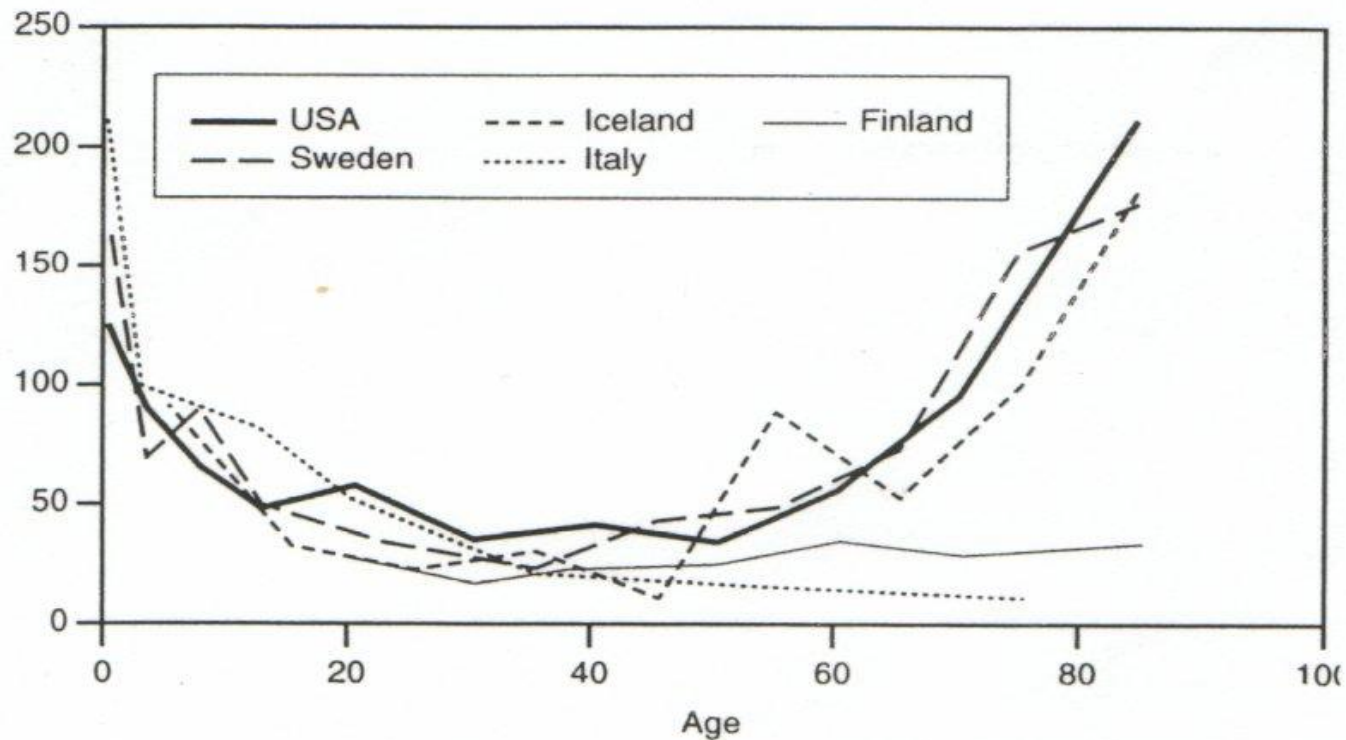
# Are all seizures the same?



- Common in children
    - Petit mal (older name)
  - Characterized by:
    - staring, expressionless, unresponsive, cessation of activity, blinking
    - often brief 2-20”; start and end abruptly
    - individual often resumes activity
    - no memory of the event
    - often mistaken for daydreaming or poor attention
-

# Why talk about epilepsy in children?

Epilepsy often starts in childhood and may persist into adulthood (life-long condition).



# Why talk about children with epilepsy at the CHERI conference?

Children with epilepsy have more  
academic underachievement compared to

- healthy peers
- siblings.

This academic underachievement is not  
explained by

- intellectual disability,
- has been found irrespective of the  
definition used

# How common is academic underachievement?

Fastenau et. al. (2008) – children with chronic seizures:

- 48% meet criteria for at least 1 LD (using a discrepancy definition)



# Why talk about memory in children with epilepsy?

Memory difficulties represent

- the most common cognitive complaint in patients with epilepsy.

Even in children with mild epilepsy

- 30% parent-reported memory problems
  - Davidson, Dorris, O'Regan, Zuberi, 2007

Children with intractable epilepsy

- 70% self-reported memory problems
    - Smith, Elliott & Lach, 2006
-

- Epilepsy related factors
    - Site of epilepsy focus/pathology
      - Temporal lobes
    - Seizures themselves
      - Interfere with registration, consolidation or retrieval of information
      - May compromise already established memory stores
        - Fluctuating performance
    - Treatment
      - Medication
        - Vary and need to be considered on the individual level
      - Surgery
        - Risk of memory loss
-

# What contributes to memory deficits in children with epilepsy?

- Psychological factors
    - Mood
      - Anxiety/depression
      - Psychosis
    - ADHD
-



# TYPES OF MEMORY PROBLEMS

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- Difficulties with attention and working memory are common in children with epilepsy
-



**Word  
retrieval  
/semantic  
memory**

“I can’t just spit out a word, a proper word. I know what I’m want to explain to you but I can’t think of a proper word and I know the word and I’m so used to the word and it could be the easiest word. I can’t get it out. I’ll have to wait and *it’ll make me really aggravated*”.



## Recall of learned material

“A lot of times when I’m talking I will know what I’m going to say to you and then for some odd reason I’ll tell you the first part of the story and then I just forgot the second part and that would be the important part. I won’t remember it for a long time or I’ll go home and go ‘that’s what it was’... *so that drives me insane*”.



## **Retention of new material over time**

“...my short-term memory is very bad...if my mom tells me to do a chore in the house or something and she leaves, I’ll forget...unless she writes it down on a paper”.

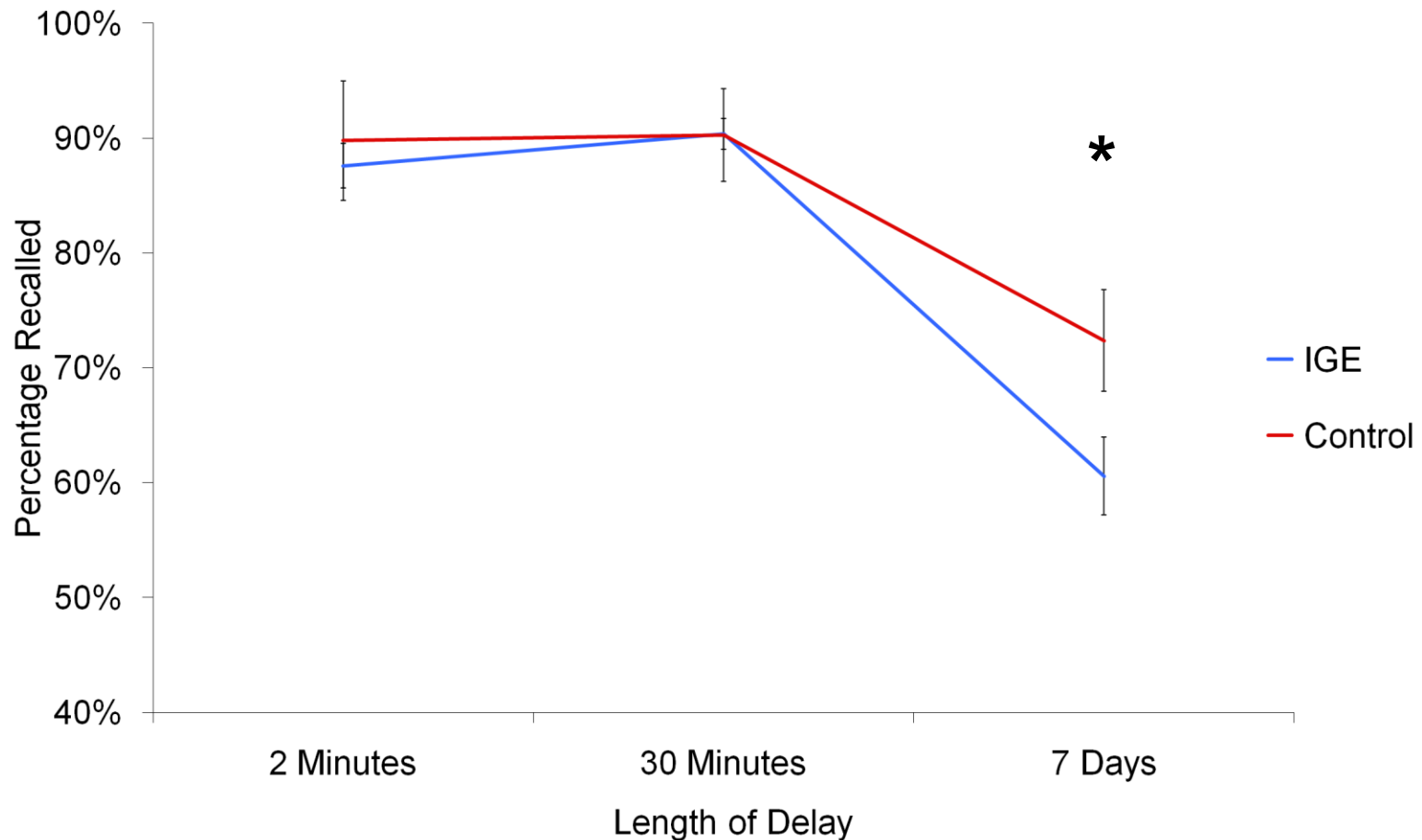




## Autobiographical memory

“I don’t remember any of my childhood... because of these seizures I don’t remember a lot of my life... I can get bits and pieces but not anything really... *it’s not very good ... I’m not happy about it*”.

## Accelerated long-term forgetting





# **HOW DO NEUROPSYCHOLOGISTS ASSESS MEMORY IN CHILDREN WITH EPILEPSY?**

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# Memory assessment

- Standardised memory tests/batteries: ability to register, learn and recall materials presented during assessment (episodic memory)

	Immediate		Delayed (20-30')	
	Working	Learning	Recall	Recognition
Verbal	Digit Sp.	List of words	List of words	List of words
Visual	Block Sp	Designs	Designs	Designs



# Learning task (example): Word list learning

- Instructions
-



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# Learning task (example): Word list learning



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Recall





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List leaning: 2<sup>nd</sup> reading





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# List learning: second recall

- 16 year old female high school student (KP)
  - lives with her parents and older siblings
  - history of epilepsy
-

- no developmental concerns until 3 1/2 years of age when changes in behaviour were noticed
  - 4 years of age - episodes of staring
  - seizures – difficult to control with medication
  - temporal lobe epilepsy
-

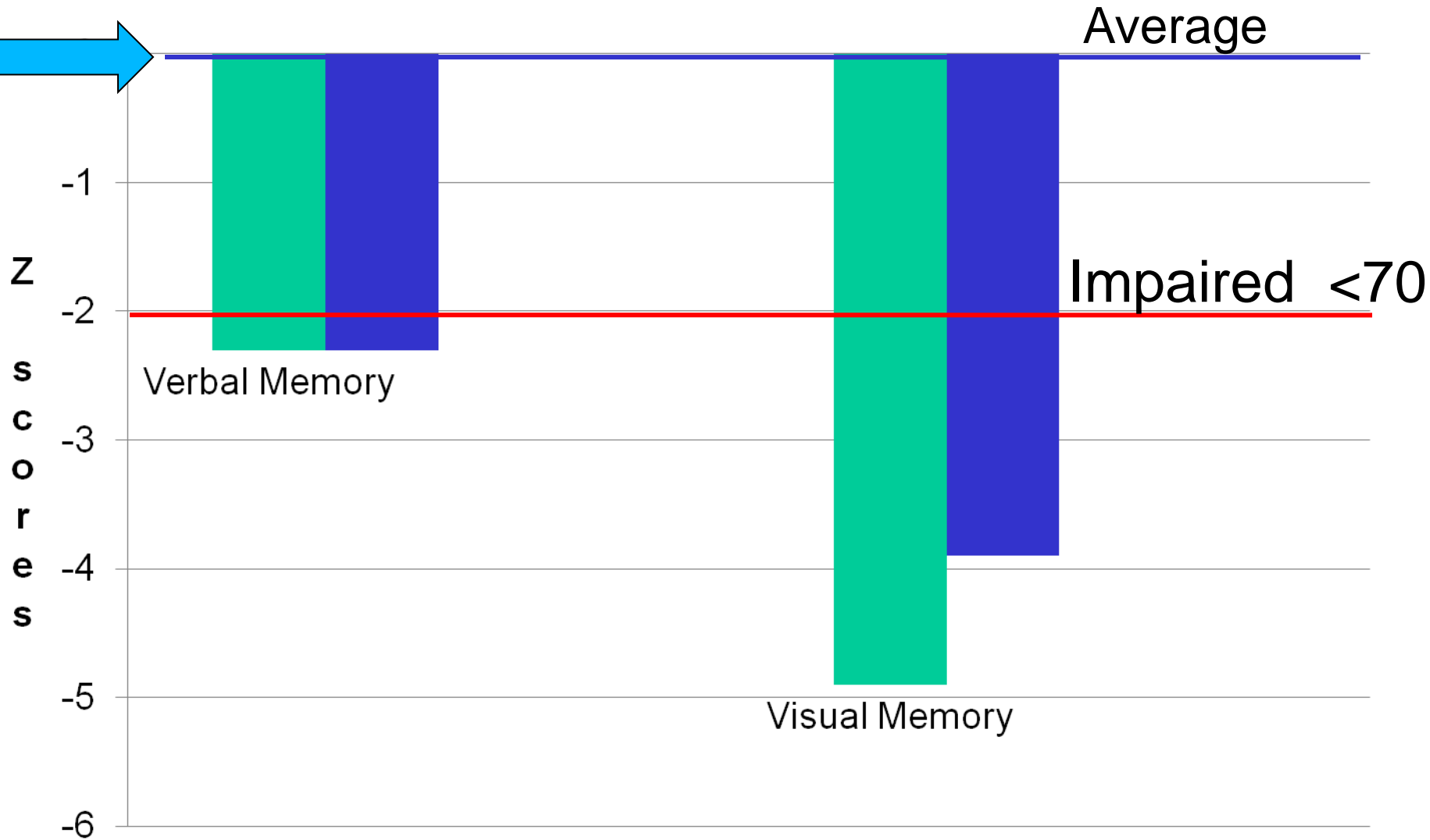


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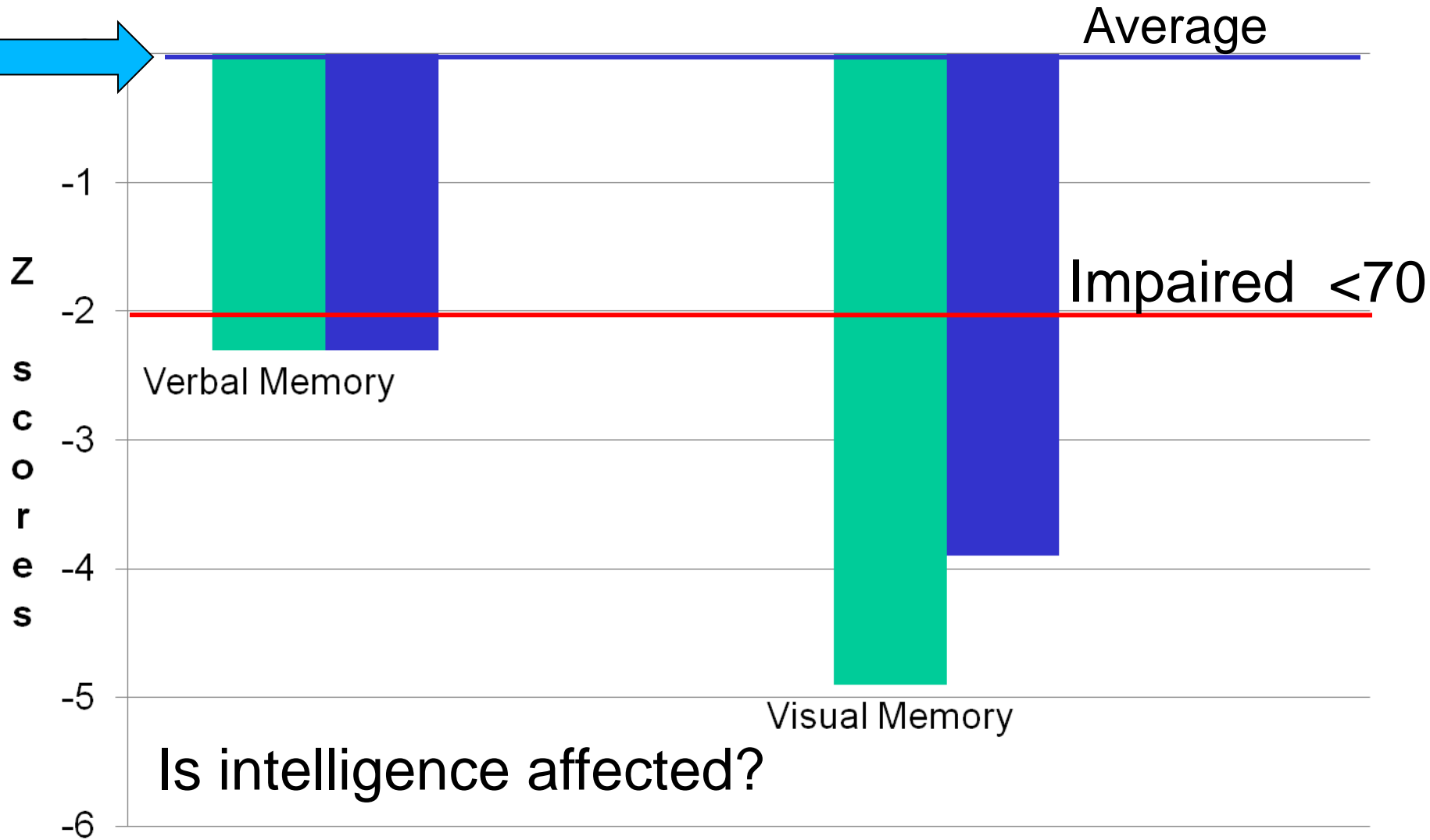


- Year 5 - fluent reader, but did not like reading because she forgot the beginning of a story before she reached the end
  - extremely poor memory - difficulties in learning new concepts and social problems
  - friendly, but anxious girl
-

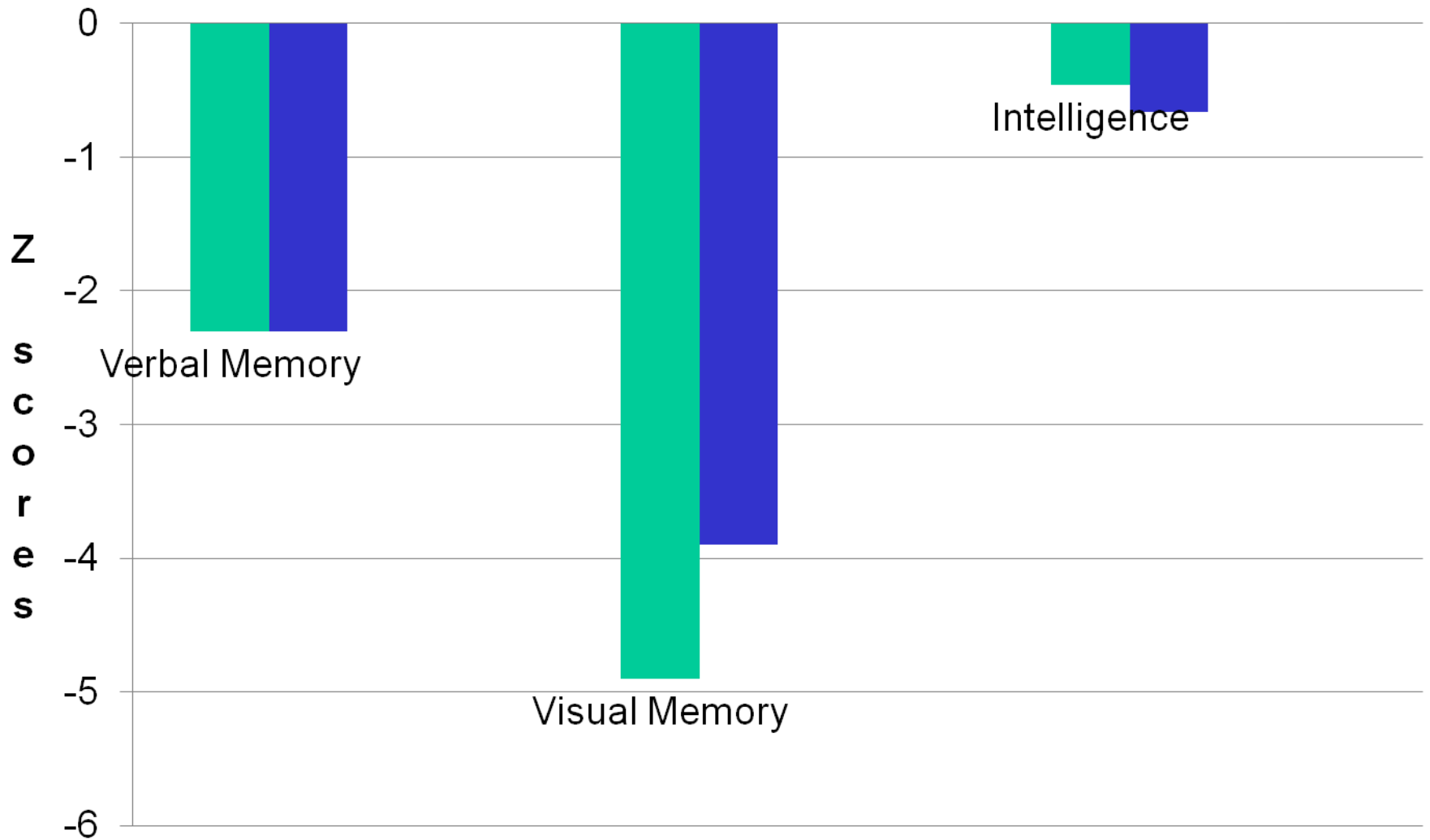
# Assessment results



# Assessment results

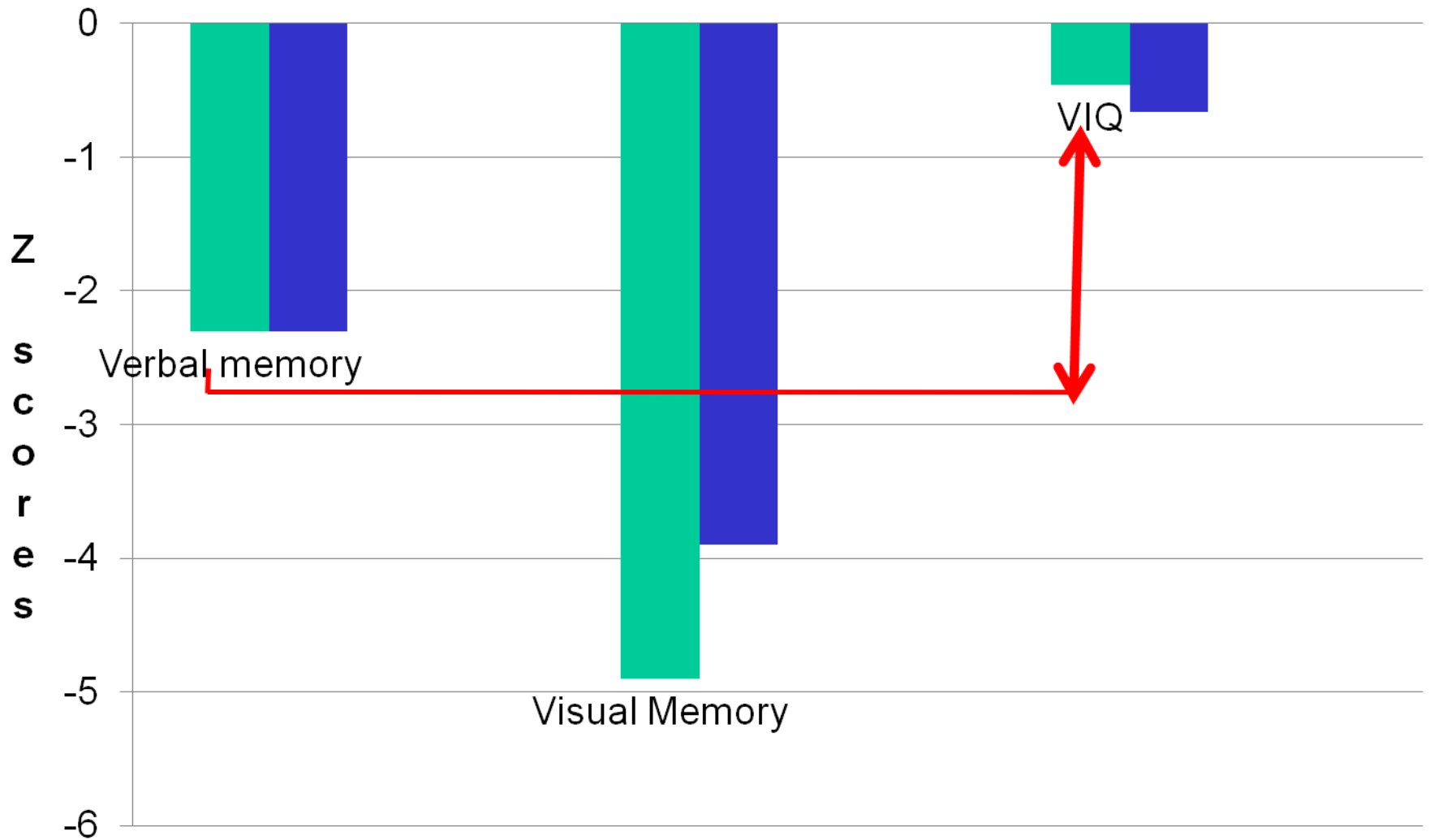


# Is intelligence affected?

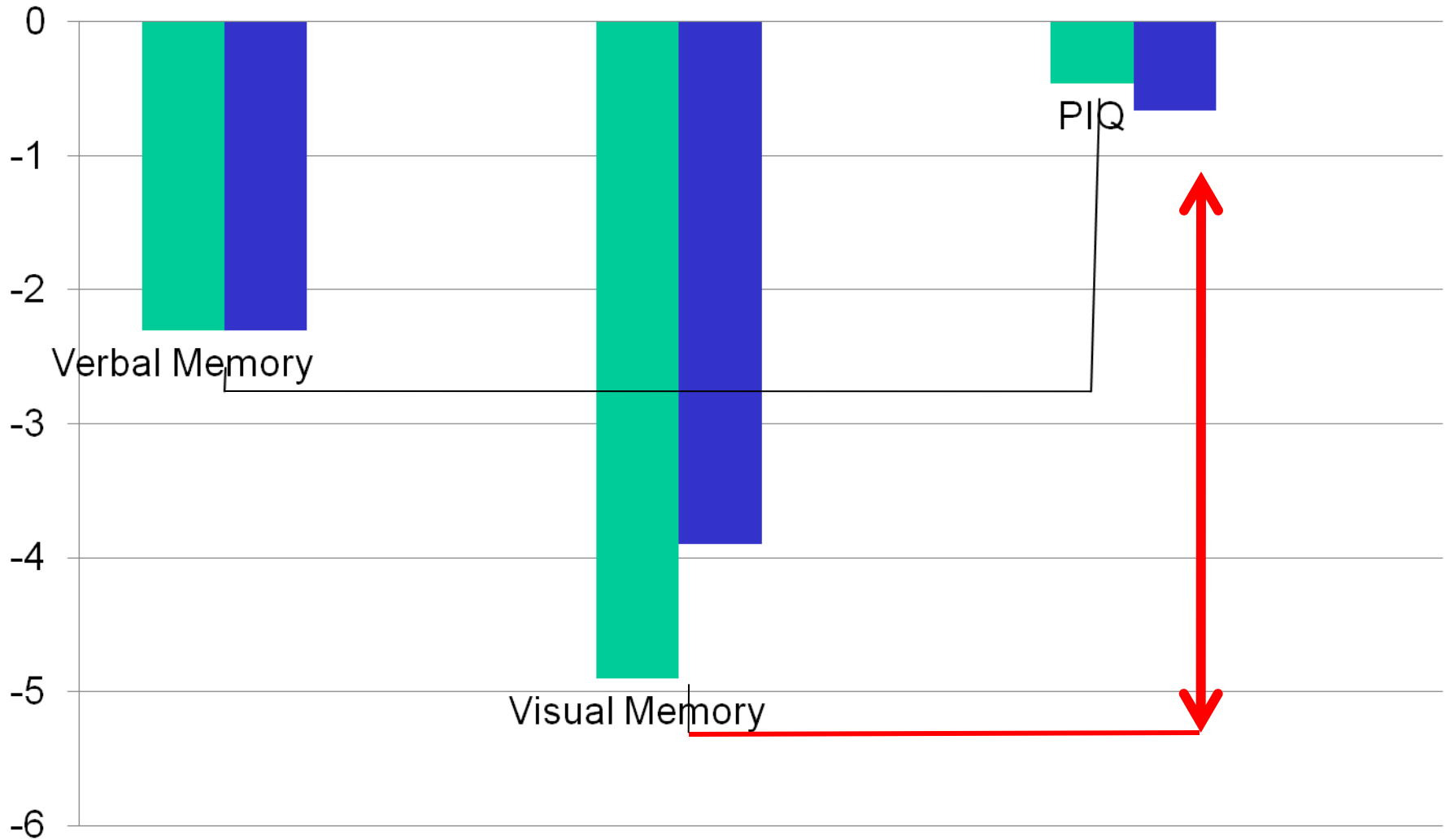




# Is intelligence affected?



# Is intelligence affected?

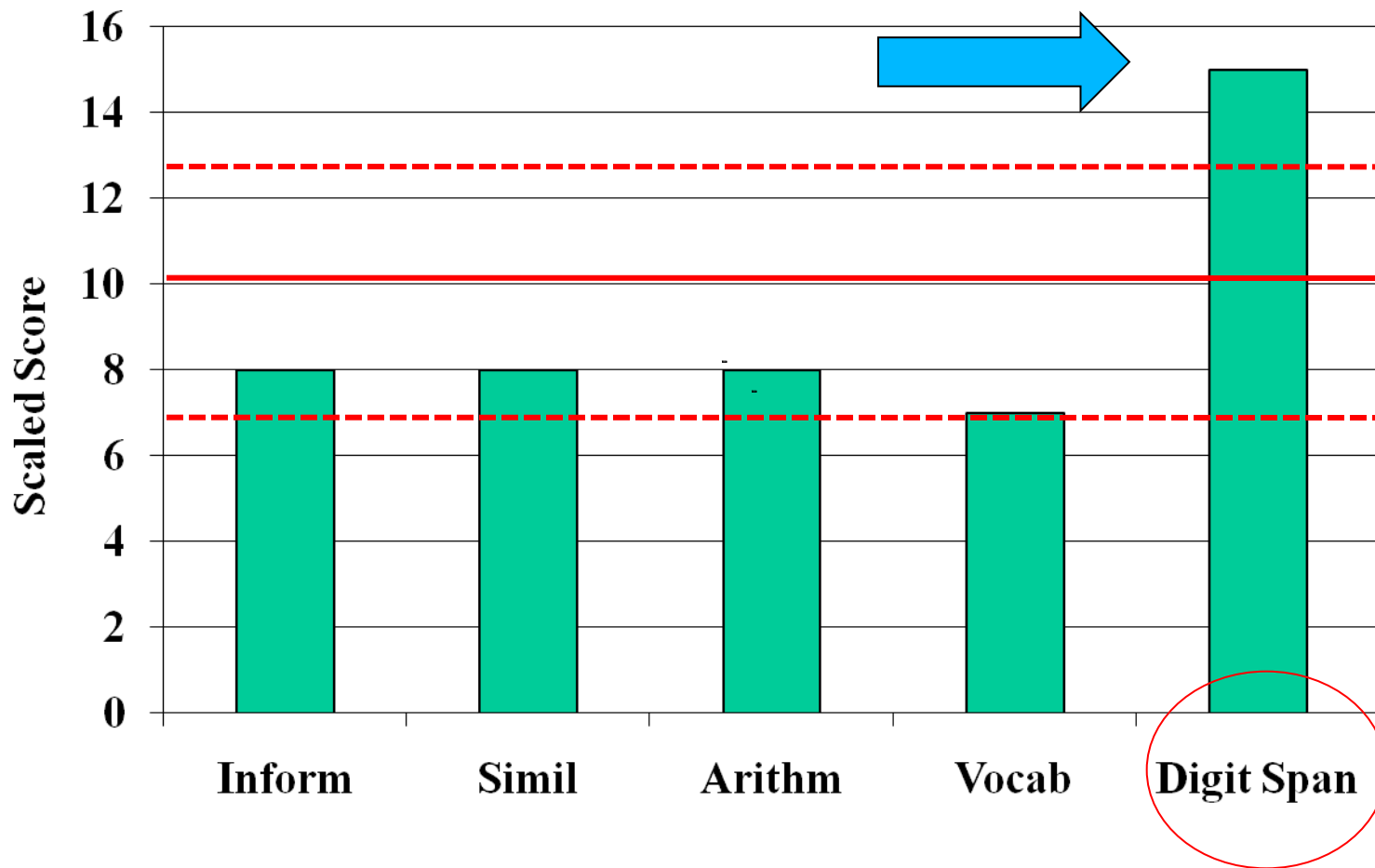




- Are there any indicators of this type of memory disorder on IQ tests?
-

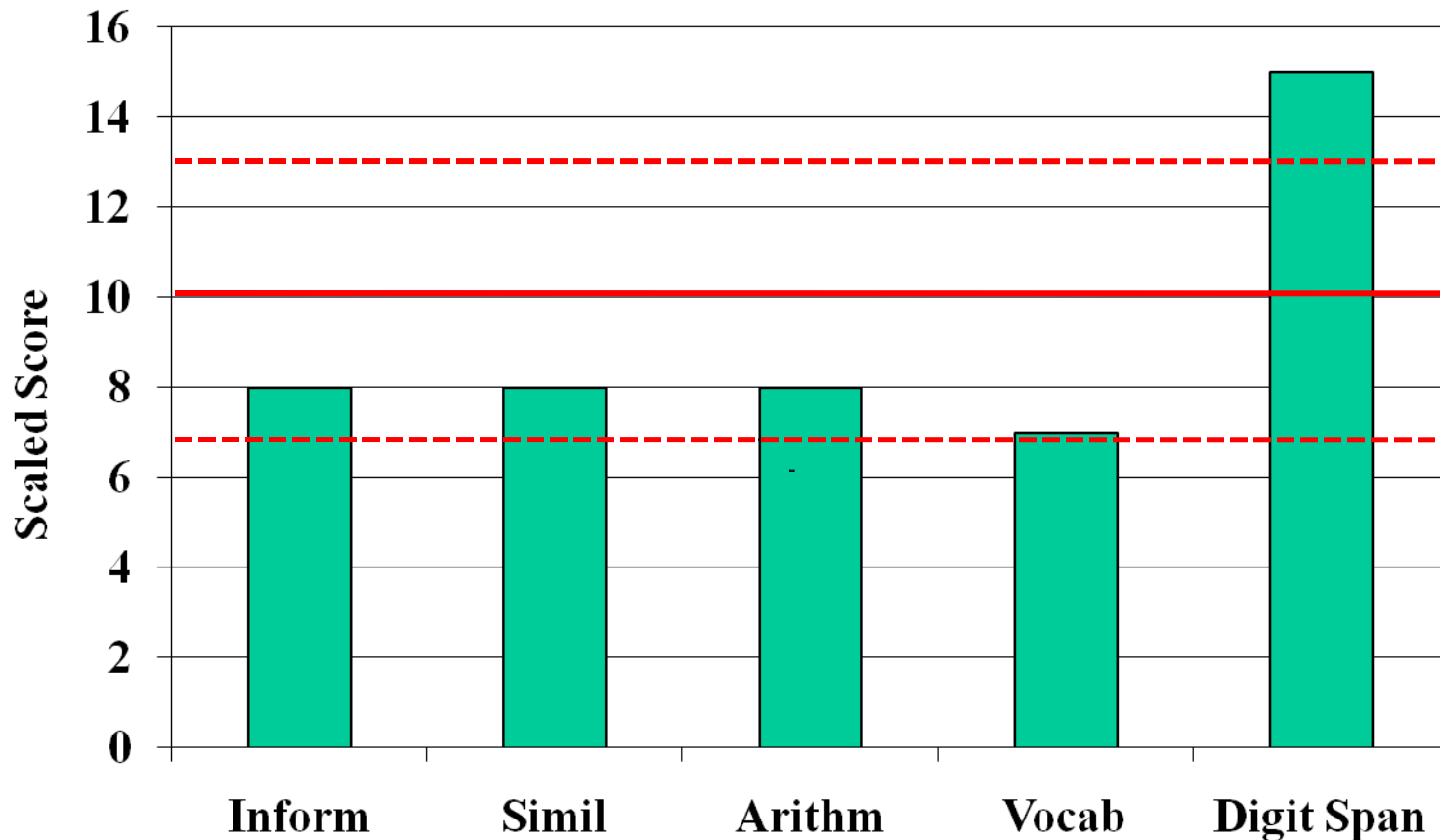


# Verbal intelligence





# Verbal intelligence



## Profound memory deficits

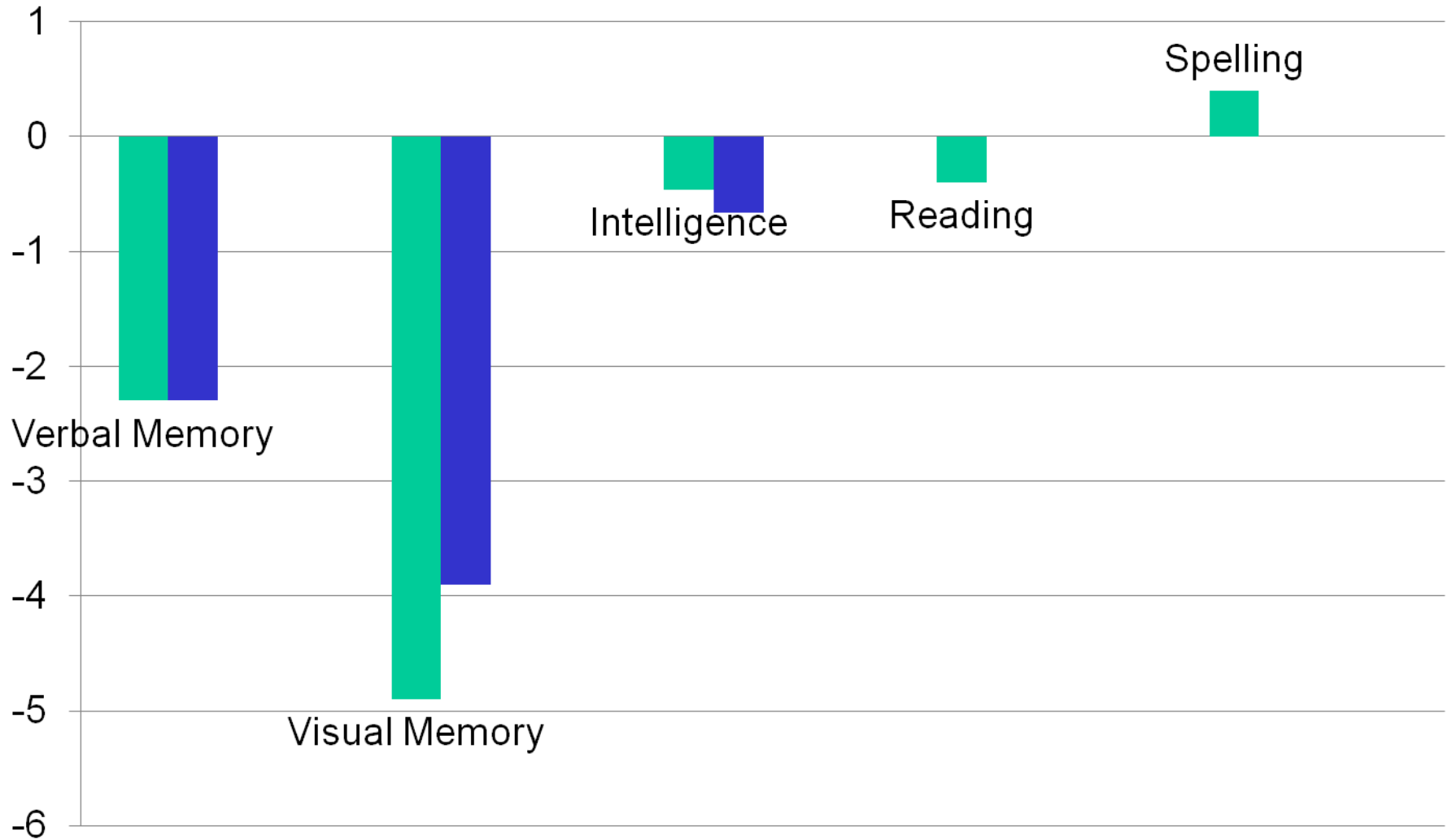
→ not apparent on the IQ tests (WISC III)

→ may be present even in children with above average working memory (Digit Span)



- Are reading and spelling skills impaired?
-

# Are reading and spelling skills affected



## Temporal lobe epilepsy

- Severe episodic memory deficit – amnesia
    - Average intellectual development
    - Age appropriate reading and spelling skills
-



## Academic

- Unable to remember what was done in the class
  - Difficulties grasping new concepts
  - Difficulties recalling specific information on demand
  - Underperformed at school despite adequate reading/spelling accuracy
-

# Are there any difficulties in day to day life?

## Social

- Problems making and maintaining friends
    - unable to remember children's faces and names
    - difficulties following conversations; forgetting the topic during a conversation
      - unable to talk/discuss favourite TV shows, video games, etc.
-

Are there any difficulties in day to day life?

## Independent living skills

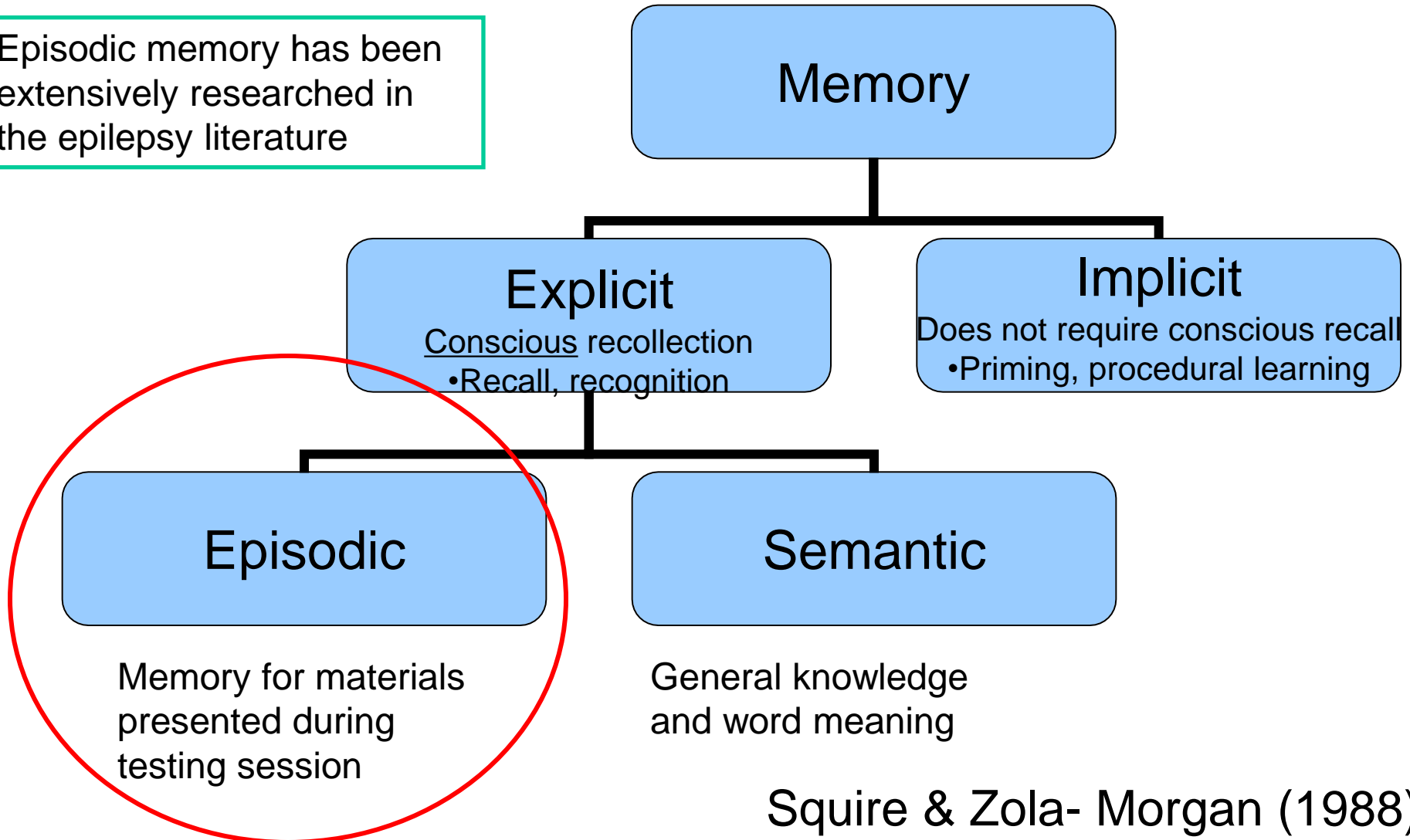
- Getting lost outside a family home (at school)
  - Unable to report what happened earlier during the day
  - At risk of being taken advantage of and not being able to report what had happened
-



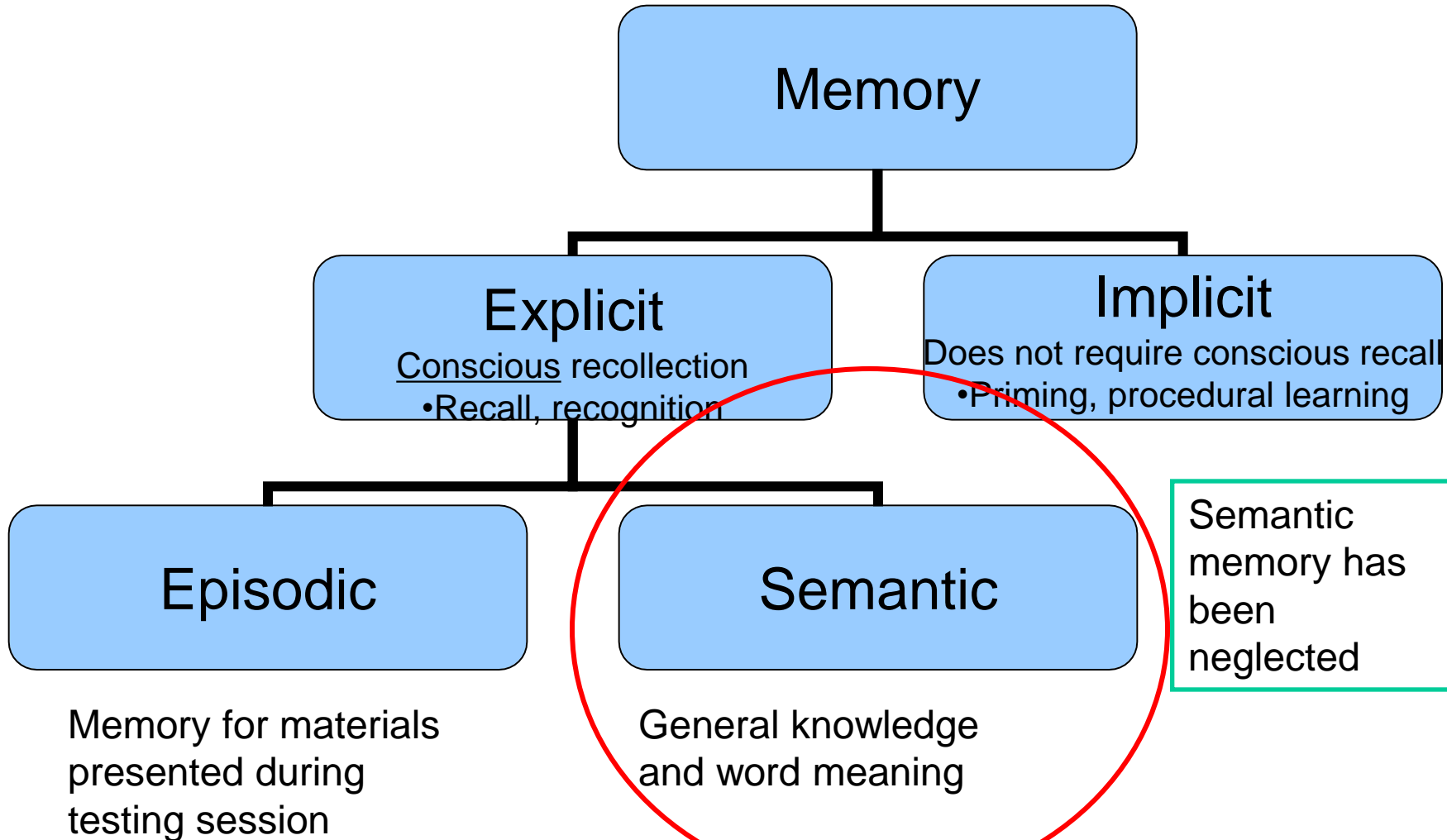
# Learning task (example): Word list learning

- Delayed recall
-

Episodic memory has been extensively researched in the epilepsy literature



Squire & Zola- Morgan (1988)



Squire & Zola- Morgan (1988)

# Why is semantic memory of interest to us?

- Adult (dementia) studies have shown that these two aspects of memory can
  - (i) be impaired independently of one another
  - (ii) have different impact on literacy skills

- Temporal lobe networks are essential for episodic and semantic memory, but also for development of literacy skills
- Children with temporal lobe epilepsy may provide the best opportunity to determine whether:
  - i) episodic and semantic memory are independent of one another
  - ii) differential impact on literacy skills development



# Smith, M.L., & *Lah*, S. (in press). *Neuropsychology.*

- Patients (n = 66) at the Hospital for Sick Children (Toronto, Canada)
- Epilepsy with a seizure focus localized unilaterally to the temporal lobe
- Underwent neuropsychological assessment between 1996 and 2009 as part of their evaluation for surgery
- Performance IQ > 69
- Aged 6 – 18 years

- › Semantic memory
    - › Naming
    - › Word Knowledge
    - › Knowledge of Facts
    - › Fluency
  - › Episodic memory
    - › Word List Recall - Delayed
    - › Story Recall - Delayed
-

# Results: Principal component analyses with varimax rotation

Task	Factors		h <sup>2</sup>
	1 (Semantic)	2 (Episodic)	
Word Knowledge	.83	...	.71
Naming	.85	...	.72
Knowledge of Facts	.75	...	.59
Fluency	.31	.51	.36
Story Recall	.45	.63	.78
Word Recall	...	.87	.78
Percent of Variance	43.51	19.06	62.57

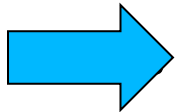
How well did children with epilepsy perform relative to the normative means?

	<i>Mean</i>	<i>t</i>	<i>p</i>
<u>Semantic</u>			
Word Knowledge	-0.59 (1.01)	- 4.74,	< .001
Naming	-1.55 (1.83)	- 6.35	< .001
<u>Episodic</u>			
Word Recall	-.51 (1.27)	-3.04	< .01

Are there individual cases who show impairment in semantic or episodic memory alone?

### Level of task difficulty

- Repeated measures ANOVA ( $F(2,49) = 11.85, p < .001$ )
  - Naming < Word Knowledge and Word Recall



Word Knowledge (Semantic) and Word Recall (Episodic) were used to classify the performance of each child as

- Intact ( $\geq 25\%$ )
- Impaired ( $\leq 8\%$ )
- Neither

# Are there individual cases who show impairment in semantic or episodic memory alone?

## Episodic (Word Recall)

### Category of Performance

Intact

Impaired

Neither

## Semantic (Word Knowledge)

Intact

18

7

5

Impaired

5

3

1

Neither

10

5

4

**Episodic** (Word Recall)  
Category of Performance

Intact                      Impaired                      Neither

**Semantic** (Word Knowledge)

Intact

18

7

5

Impaired

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Episodic (Word Recall)  
Category of Performance

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Semantic (Word Knowledge)

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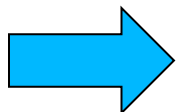
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**Double dissociation**



- Some children could hear, repeat, store and recall information after a delay
  - without knowing the meaning of that information in the first instance, or learning the meaning in the meantime
- In contrast, other children may not be able to recall information on demand after a delay
  - although they have good understanding of the meaning of the information



both types of impairments are likely to impact on child's living skills, communication and academic skills, but possibly in different ways.

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- What is the relation between semantic and episodic memory and literacy skills?
-

# Correlations between literacy and memory skills

	Reading accuracy	Reading comprehension	Spelling accuracy
Semantic	57**	72**	55**
Episodic	25	24	30*



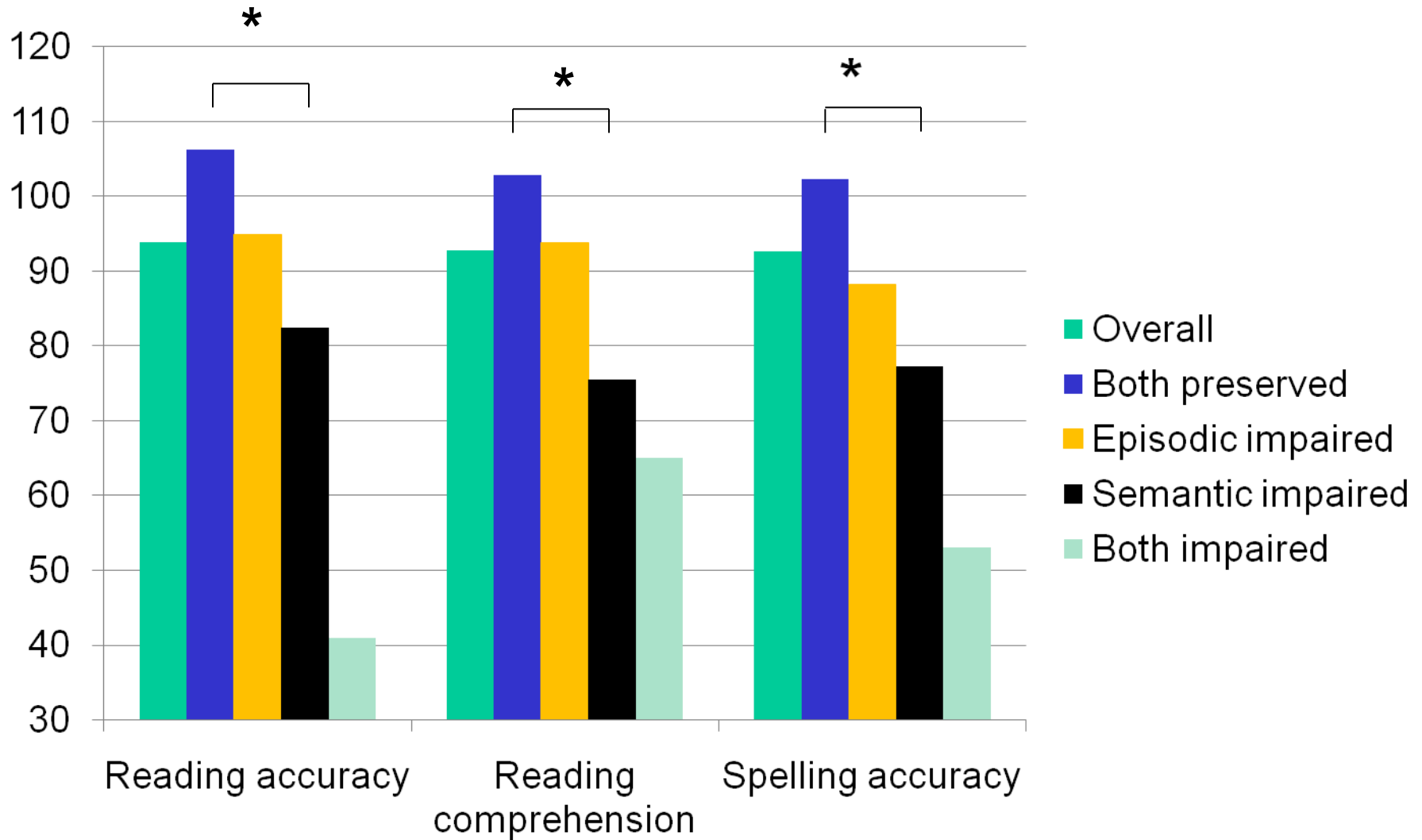
Episodic (Word Recall)  
Category of Performance

Intact                      Impaired                      Neither

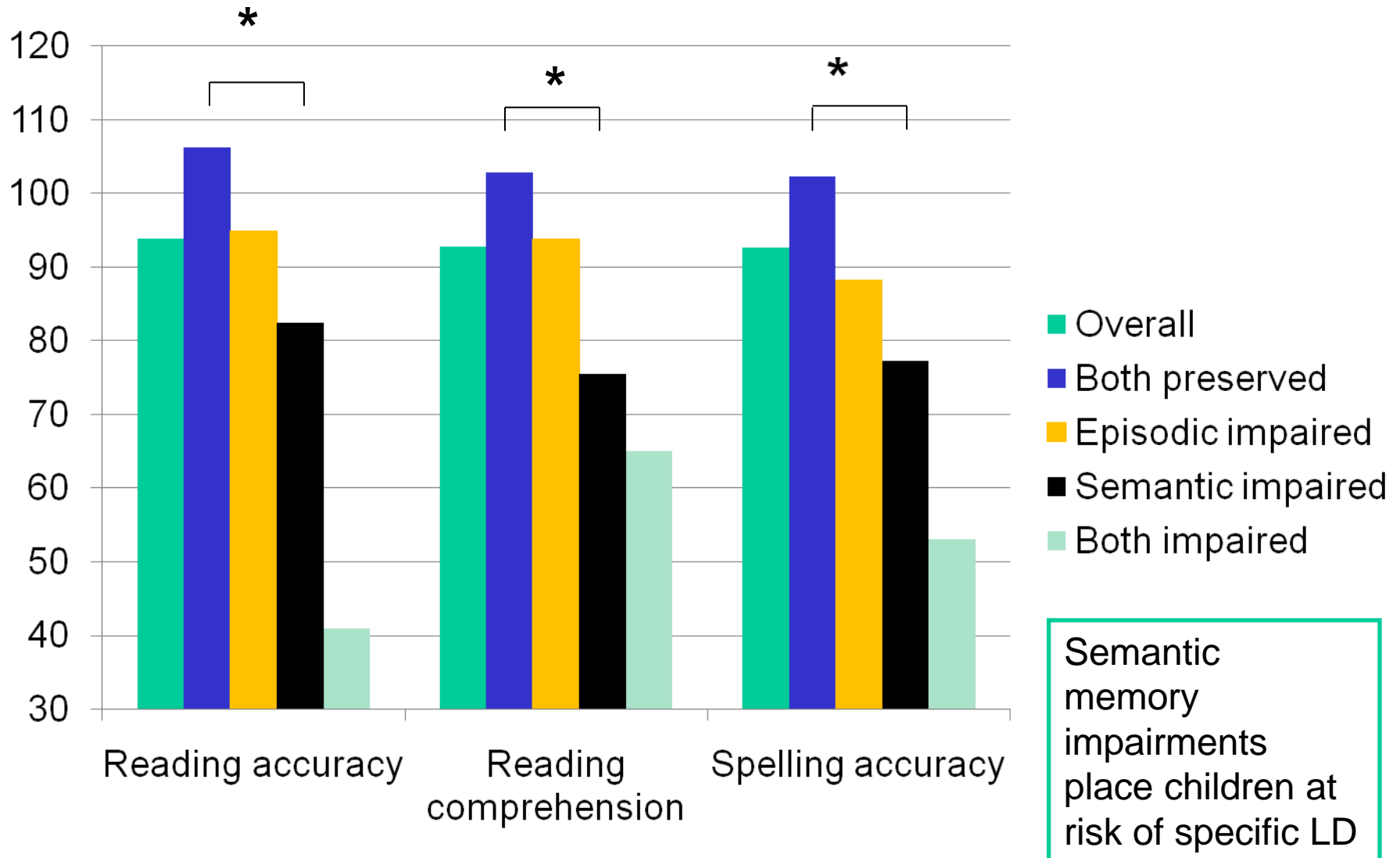
Semantic (Word Knowledge)

Intact	18	7	5
Impaired	5	3	1
Neither	10	5	4

# How do these to memory systems relate to reading and spelling skills?



# How do these to memory systems relate to reading and spelling skills?





# **INTERVENTIONS FOR CHILDREN WITH EPILEPSY AND MEMORY DEFICITS**

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# Interventions for children with epilepsy and memory difficulties

Given the range of memory difficulties that may be present independently of one another

- a range of different interventions/strategies may need to be employed





- Child literature

- very small number of published studies on memory rehabilitation
- predominantly single case studies
  - little evidence of generalisation

# Interventions for children with memory difficulties in day to day activities

## Adult literature

1. Use of internal strategies → enhance learning and retention of information over time
  - difficulties with generalisation
2. Use of compensatory aids (i.e. diaries)
  - compensated for deficits in day to day living
  - improved attention and memory skills
3. Diary and self instruction training
  - best outcomes

- Significant ABI, > 12 months post injury
  - Age 11 – 18
  - FSIQ > 79, Reading > Y3
  - Memory difficulties in everyday life
-

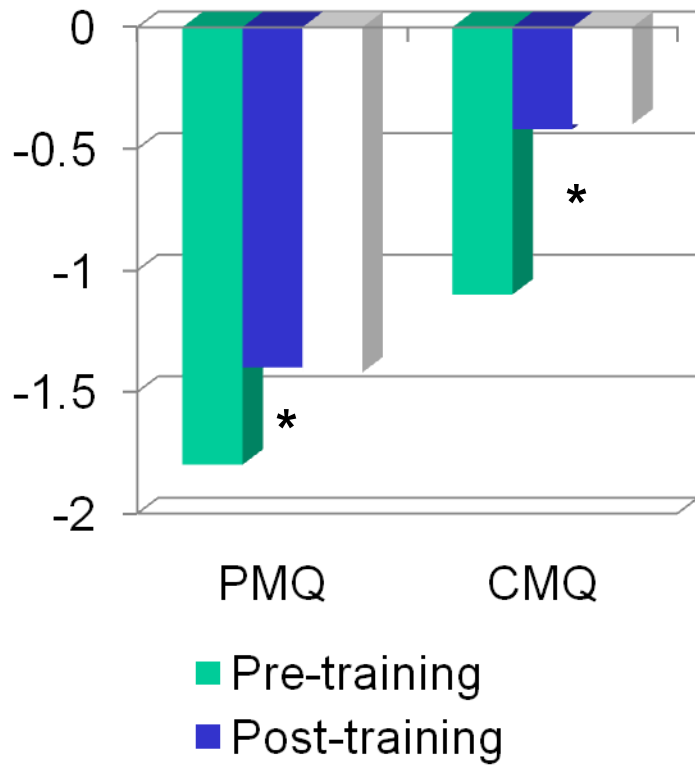
## Treatment

- Specifically developed materials: manual and workbook
  - Six 1.5-hour sessions – small groups
  - *Diary training* (Sohlberg and Mateer, 1989)
    - Acquisition: names, purpose & use of each diary section
    - Application: when and where to use it (case studies, role plays)
    - Adaptation: skills utilisation in everyday life was discussed and encouraged
-

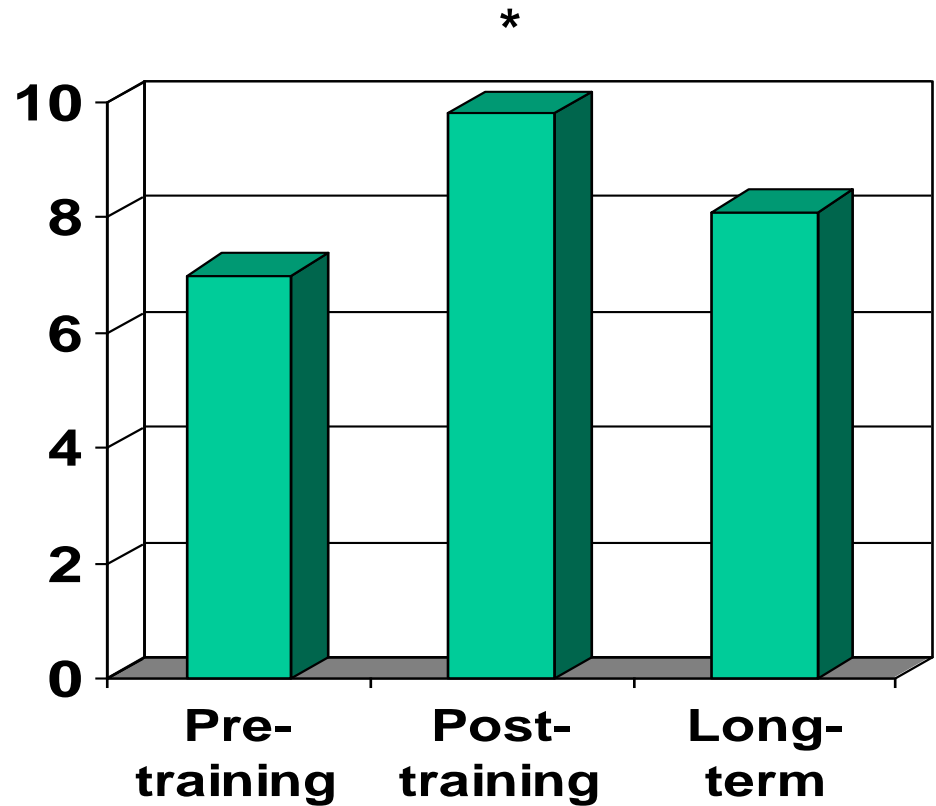
## Treatment - continues

- *Self instructional training* (Ownsworth & McFarland, 1999)
    - W – What are you going to do?
    - S – Select a strategy for the task (*Strategy Selection*);
    - T – Try out the strategy (*Strategy Initiation*);
    - C – Check out how the strategy is working (*Monitoring*).
-

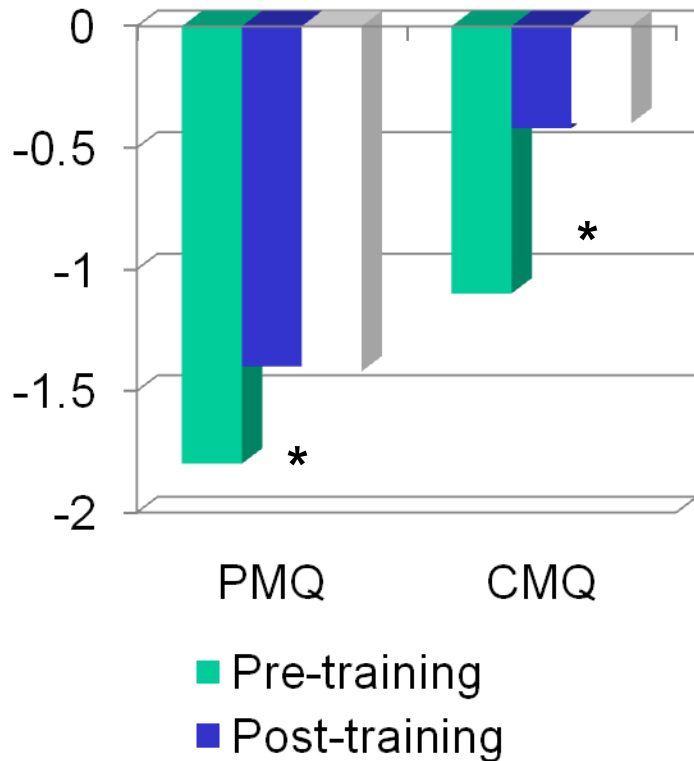
## Questionnaires



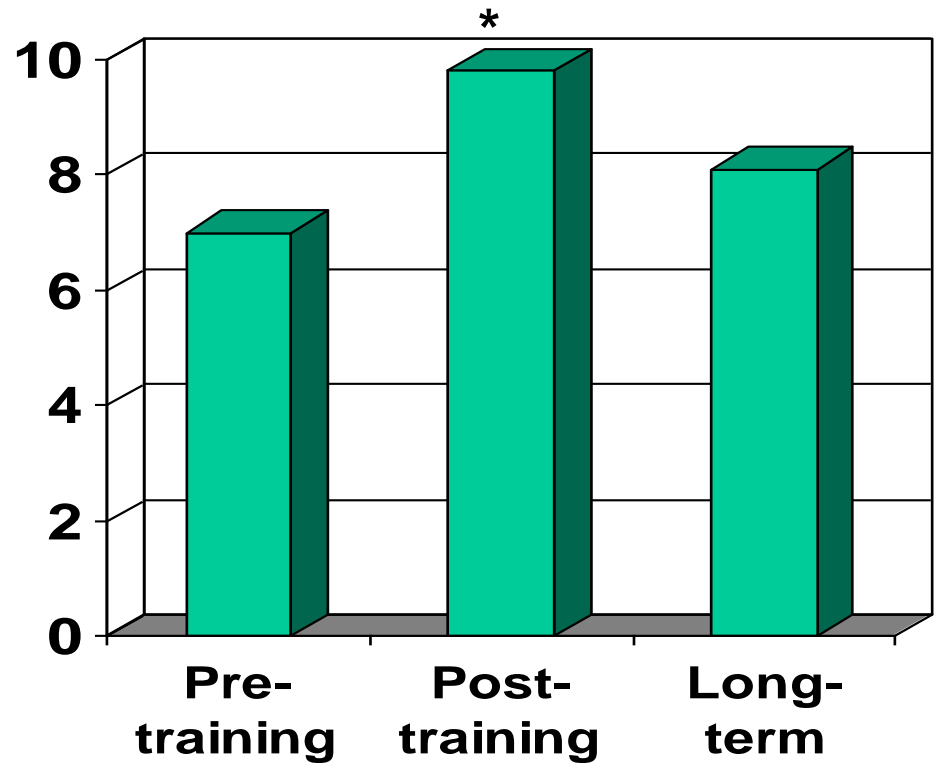
## Diary Use



## Questionnaires



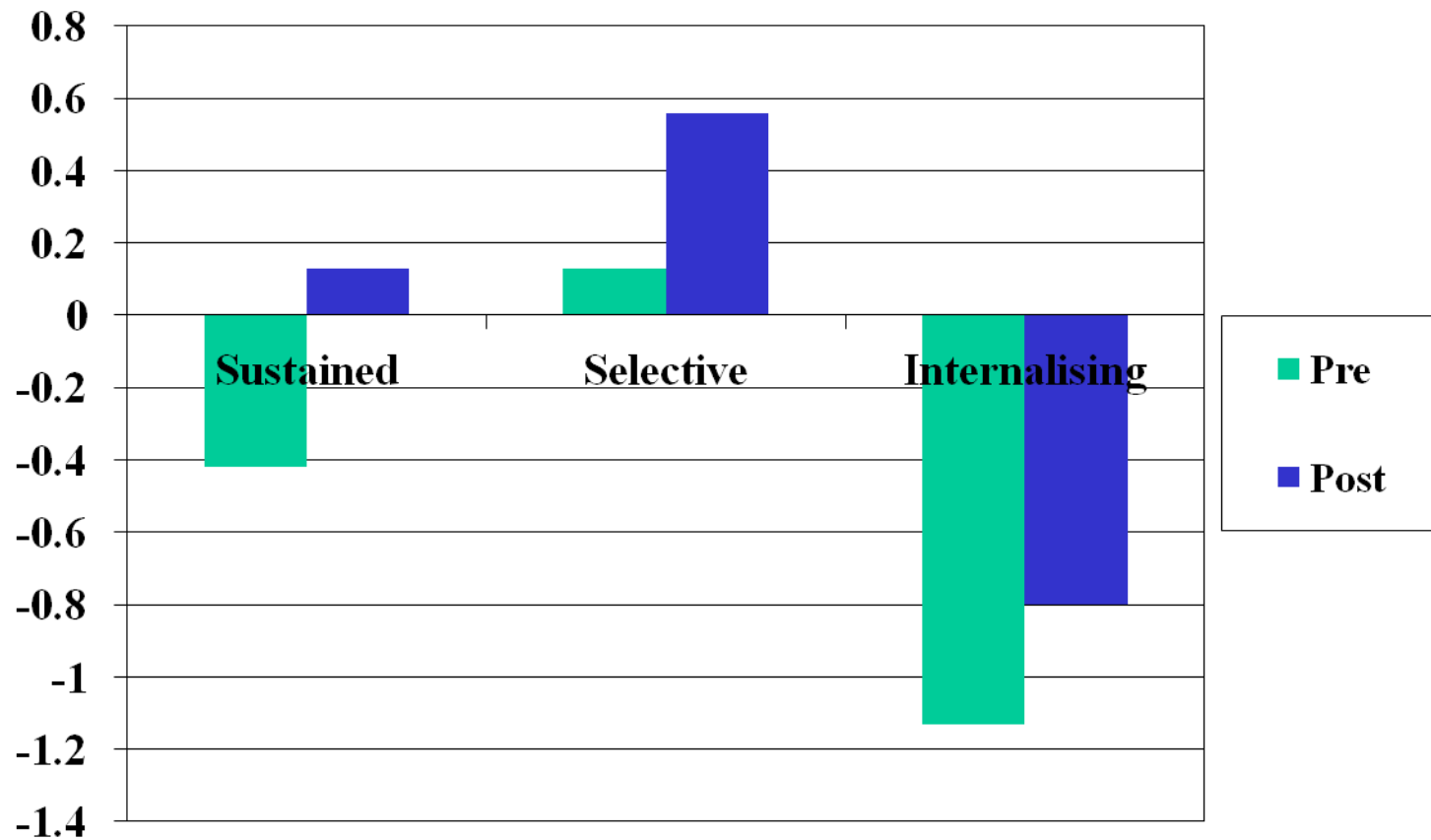
## Diary Use



Children who used diaries more often reported greater improvement in everyday memory ( $r = .58$ )



# Secondary gains





## Outcome

- reduction in everyday memory difficulties
  - secondary gains in attention and mood
    - may be due to the self-instruction component being included in the training
-

- Children with epilepsy are at an increased risk of memory deficits
  - Types of memory deficits:
    - Registration/working memory
    - Learning
    - Retention
    - General stock of knowledge
    - Recall of information from the past
  - Assessment of memory
    - Standardised tests – different from the tests of intellectual functioning
  - Impact of memory deficits
    - Academic, social, independence and psychological well being
  - Interventions
    - Underdeveloped
-

- Students
    - Joanna Ho, Michael Gascoigne
  - Sydney Children’s Hospital (ABI)
    - Adrienne Epps, Louise Parry, Miriam Poole
  - Westmead Children’s Hospital (Epilepsy)
    - Belinda Barton, Richard Webster, Deepak Gill
  - Hospital for Sick Children Toronto (Epilepsy)
    - Mary Lou Smith
-

Child Memory Clinic  
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University of Sydney NSW 2006

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Fax: (02) 9351 7328

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	Group		Effect Size, p
	Intact <u>Episodic</u> Impaired Semantic	Intact <u>Semantic</u> Impaired Episodic	
Vocabulary **	-1.80 (.18)	0.00 (.51)	R <sup>2</sup> =.85, p <.001
Word Recall**	- 0.05 (.59)	-2.18 (.36)	R <sup>2</sup> =.86, p<.001
Performance IQ	88.88 (12.56)	100.14 (11.23)	R <sup>2</sup> =.21, p = .13
Age	14.63 (1.77)	14.79 (2.11)	R <sup>2</sup> =.00, p = .89
Age at Sz. Onset	7.10 (4.70)	9.13 (5.38)	R <sup>2</sup> =.04, p = .51
# AEDs	2.00 (.71)	1.29 (0.49)	R <sup>2</sup> =.30, p = .06

Also, no significant difference in: sex, handedness, *laterality of seizure focus*, laterality of speech representation, presence of comorbidity, whether or not they eventually had surgery, type of seizures, history of secondarily generalized seizures, or seizure frequency .

Impaired semantic, but preserved episodic memory: Is it rare?

- somewhat lower (n=5, 8.6%) than the opposite pattern (n=7, 12.1%)
- higher than in the general population (< 1%)

 has remained undetected in children with temporal lobe epilepsy until now



- Two memory systems can develop independently of one another, and in parallel (Temple and Richardson, 2004)
- Model proposed by Graham, Simons, Pratt, Patterson, & Hodges (2000) is applicable in paediatric context

