Attention, memory and learning and acquired brain injury

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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

Biological factors: brain correlates

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

The Information Processing System

“MANAGEMENT”
Organising, problem solving

Conceptual model for influences on information processing
Memory and learning models

- Specific language & learning difficulties, acquired brain injury
- Not usually found in children

The limbic system – ‘memory’

- Important for encoding and retrieval – observed in children with epilepsy

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, motor cortex
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

Outline

- Memory and learning models
- Development of memory and learning skills
- Disrupted memory and learning
- Conclusions
The Information Processing System

"MANAGEMENT"
Organising, problem solving

Attention
Acquisition/Registration
Storage & Learning
Output/Motor Activity

Impaired Information Processing System

"MANAGEMENT"
Organising, problem solving

Attention
Acquisition/Registration
Storage & Learning
Output/Motor Activity

Biological and developmental underpinnings of long-term sequelae
Deficient development and/or loss of brain tissue in the following brain areas:
- White matter (information processing, attention)
- Hippocampal formation (memory function)

In infancy and childhood these brain regions are rapidly developing and thus particularly vulnerable to insult
Short- and long-term brain changes have been identified

Testing for memory problems
- Capacity
  - Digit span, block span, sentence repetition
- Processing speed
  - Coding, Symbol Search
- Working memory
  - Digits backwards, Letter sequencing
- Memory strategies
  - CVLT, Hopkins, Rey Figure

Learning and memory problems post-ABI

Attention deficits post-ABI
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

<table>
<thead>
<tr>
<th></th>
<th>ADHD</th>
<th>LD</th>
<th>ADHD +LD</th>
<th>ADHD + CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustained att.</td>
<td>-</td>
<td>--</td>
<td>--</td>
<td>*</td>
</tr>
<tr>
<td>Selective att.</td>
<td>-</td>
<td>--</td>
<td>--</td>
<td>*</td>
</tr>
<tr>
<td>Impulsivity</td>
<td>-</td>
<td>*</td>
<td>-</td>
<td>--</td>
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<tr>
<td>Response speed</td>
<td>*</td>
<td>--</td>
<td>--</td>
<td>*</td>
</tr>
<tr>
<td>Memory/learning</td>
<td>*</td>
<td>-</td>
<td>--</td>
<td>*</td>
</tr>
</tbody>
</table>

* normal, - mild impairment, -- severe impairment

Biological

Cognitive

Behavioural

Psychologic

ATTENTION

ADD/ODD/CD

ADD

ADD/LD

Inattention

Hyperactivity/Impulsivity

A case of ‘amnesia’ following appendectomy

Jamie M.
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 esterase) 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

<table>
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<tr>
<th>Test Type</th>
<th>3mth</th>
<th>1 year</th>
<th>3y 6mth</th>
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<tbody>
<tr>
<td>Word lists (SS)</td>
<td>6</td>
<td>4</td>
<td>4</td>
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<tr>
<td>(2,4,4, 10, Del = 0)</td>
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<tr>
<td>Picture lists (SS)</td>
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<td>3</td>
<td>3</td>
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<tr>
<td>(1,1,6,3, Del =2)</td>
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<tr>
<td>Story Recall (SS)</td>
<td>5</td>
<td>-</td>
<td>-</td>
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<tr>
<td>(11, 3, Del 0,1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sentences (SS)</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

Scaled score: Average range =10 ± 3
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

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