Thinking and Memory in MS

Ben Harris (MPsyCh, PhD)
Clinical Neuropsychologist

Overview

• Basic structure of the brain and how signals are communicated between different areas
• Changes to the brain associated with MS
• Different areas of cognitive function and how they can be impacted by MS
• Functional difficulties associated with cognitive changes
• Not covering management and rehabilitation strategies today
Case example

- Sally is a 38yo woman diagnosed with relapsing-remitting MS 10 years earlier
- Several relapses in the first two years associated with left arm weakness, pins and needles, balance problems and urinary urgency
- Medically stable with few relapses in the past seven years
- Lives with husband and has a 5yo son who has just commenced school
- Works 3 shifts per week in a local supermarket

Case example

- More difficulty functioning in the past two years despite stable physical function
- Memory and concentration problems at home and work
- Late to pick up son from school once and missed a shift at work
- Less able to keep up with domestic chores
- Increasingly fatigued
- Feeling highly anxious
MS overview

• Highly variable illness course:
  – Relapsing-remitting
  – Secondary progressive
  – Primary progressive

• Variable effect on a person’s cognitive function, mobility, other physical functions, mood, etc.

• Changes to cognition can be unrelated to changes in physical function

Basic brain structure and function

• Individual neurons

• Networks of neurons
Grey matter
- cell bodies and dendrites of the neurons
- where the messages “synapse”

White matter
- the axons of the neurons
- carry information from one neuron to another

Grey matter
- Makes up what we refer to as the different ‘lobes’ of the brain:
  ◦ Frontal
  ◦ Parietal
  ◦ Temporal
  ◦ Occipital

- Different regions of grey matter play different roles in terms of thinking and memory functions
White matter

• The way in which information is taken from one neuron to another
• Critical to effective communication between regions of the brain
• Is white because axons are coated in a fatty substance called ‘myelin’
• ‘White matter tracts’ are made up of huge numbers of axons travelling together

MS and myelin

Inflammation leads to demyelination

Demyelination leads to transmission problems within the brain
**MS changes on MRI**

**MS and cognition**

- MS is a disease of the white matter, so tends to affect cognitive processes that particularly rely on effective communication between multiple areas of the brain.
- Severe cognitive impairment is rare but milder changes are common, i.e. between 40 and 70% of people when assessed properly.
- Much research over the past 30 years has identified areas of cognition that are more and less likely to be affected by MS.
- Significant individual variation.
Flow of information in the brain

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Processing Speed

- The most common cognitive problem in MS
- Is a general measure of a person’s cognitive efficiency
- Refers to our ability to absorb and manage information in an effective and time-efficient fashion
- Relies on the integrity of white matter in the brain
Processing Speed

- Slowed processing can be associated with:
  - Difficulty keeping up with conversations
  - Difficulty understanding instructions
  - Difficulty learning new tasks
  - Needing longer to complete tasks
  - Inefficient memory for new information

Attention

- Best considered in conjunction with processing speed as both reflect a person’s ability to efficiently manage and handle information in the environment
- Basic attention (e.g. repeating numbers) is often not majorly affected by MS
- Complex and sustained attention represent another very common cognitive problems in MS
Attention

- Complex attention refers to a person’s ability to maintain information in their mind for a short time and to manipulate that information
- Example: mental arithmetic
- Difficulties with complex attention and processing speed interact:
  - As the demands on attention increase, performance slows down and information is less able to be held in mind
  - Experienced as information overload

Attention

- As with reduced processing speed, problems with attention result in:
  - Difficulty focusing on conversations
  - Difficulty filtering out unwanted information
  - Difficulty with ‘prospective’ memory, i.e. remembering to remember something later on
  - Inefficient memory for new information
- Fatigue is known to majorly impact complex attention abilities
Memory

- 3 stages to effectively remembering something:

- Most common reason for memory problems in MS is inefficiency at the first stage:

  - Encoding: Information is converted for storage
  - Storage: Information is retained in memory
  - Retrieval: Information is recovered from memory when needed
Memory

- Consolidation processes rely on circuits within the brain that are largely unaffected by MS.
- Information successfully processed is generally retained at a normal rate.

Memory

- Problems may occur in the retrieval of information that has recently been learnt.
- May relate to information having initially been poorly organised and attended to during encoding.
Executive Functions

- A collection of cognitive processes that underlie more complex and goal-directed behaviour
- ‘Executive’ refers to the boss of the company, i.e. responsible for managing the performance of all the individual employees to achieve a good outcome for the whole company
- Executive functions are required when we face unusual or complicated situations in daily life

Executive Functions

- ‘Executive function’ is an umbrella term that includes:
  - Problem-solving
  - Planning and organising
  - Initiating behaviour
  - Self-monitoring performance
  - Self-correcting and thinking flexibly
  - Reflecting
- Example: cooking a complex meal
Executive Functions

• Rely on the integrity of the whole brain, particularly the frontal lobes
• Frontal lobes vastly interconnected with all other brain regions via white matter tracts

Executive Dysfunction

• Generating new ideas, e.g. how to solve a problem, what to talk about, what to do
• Planning ahead and organising/prioritising what will be done
• Thinking flexibly, i.e. not getting stuck on one idea or approach if it is not working
• Decision making, i.e. being able to weigh up different options, considering other points of view
• Inhibiting unwanted responses to a trigger, i.e. not ‘blurting something out’
• Having insight or awareness, i.e. the ability to accurately weigh up your performance as others would see it
Less Common Cognitive Problems

- Basic attention
- Essential verbal skills, i.e. language comprehension and production
  - Word finding difficulties can be seen
- Visuoperceptual skills variably affected
  - Optic neuritis
  - High lesion burden or specific location can affect more complex perceptual processes

Other Factors Affect Cognition

- Fatigue
  - Possibly the most common symptom of MS, i.e. reported in over 90% of people
  - Decreased performance seen over time, i.e. harder to sustain effort
- Mood and Anxiety
  - Well known in studies of non-MS populations to be associated with reduced attention and memory
  - Symptom improvement can lead to cognitive improvement
Functional Impact

- Effects on daily living have been seen in studies of many different neurological problems, e.g. traumatic brain injury, stroke
- Subtle cognitive problems tend to only be noticed in more demanding situations (e.g. work) and not more basic activities
- Problems with more basic activities can be seen when environmental factors place pressure on attention, processing speed, etc.

Case Example

- Sally is a 38yo woman diagnosed with relapsing-remitting MS 10 years earlier
- Lives with husband and has a 5yo son who has just commenced school
- Works 3 shifts per week in a local supermarket
- Memory and concentration problems at home and work
- Late to pick up son from school once and missed a shift at work
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Case Example

- Cognitive assessment showed:
  - ‘Average’ lifelong level of ability
  - Mild inefficiency with complex attention
  - Mild slowing of processing
  - New learning mildly reduced but good recall after a delay
  - Mild weakness with complex problem-solving but no other signs of executive difficulty
  - Language and visuoperception at expected level

Case Example

- Mild cognitive difficulties in the areas noted can have real impact on daily functioning
- Problems with complex attention can affect ‘prospective memory’:
  - Forgetting work
  - Forgetting school pick-up
  - Distracted from tasks at home, i.e. intend to start something and then don’t or side-tracked
- Increased demands on Sally (i.e. juggling a young child, working, running the household) rely on increased cognitive processing
- Subtle inefficiencies are more noticeable in this environment
Case Example

- Trying to keep up with numerous demands is associated with fatigue and so worse cognitive functioning
- Difficult circumstances associated with anxiety and low mood which further reduces performance

Where to go for Help

- MS Connect
- Neurologist
- General Practitioner
- Psychologist
- Neuropsychologist
Next Time

- Strategies to assist in the management of cognitive and functional problems
- Suggestions for areas on which to focus