Disorders of Memory

You have to begin to lose your memory, if only in bits and pieces, to realize that memory is what makes our lives, our memory is our coherence, our reason, our feeling, even our action. Without it, we are nothing. (Luis Buñuel)

What Is Memory?

- Dynamic and malleable; goes forward and backward in time
- Forms the basis of experience and perceptions of the self
- Often taken for granted because it’s most noticeable when it’s not working
- Multiple memory systems and processes
  - But memory is not like a VCR

Memory Schematic
Taxonomy of LTM

LTM

- Implicit
  - Priming
  - Conditioning
- Explicit / Declarative
  - Procedural
  - Episodic
  - Semantic

Memory Problems

- A Schematic Definition of Retrograde Amnesia and Anterograde Amnesia

  - Retrograde Amnesia: Cannot remember events prior to brain damage
  - Brain damage occurs

  - Anterograde Amnesia: Cannot later remember events that occur after brain damage

  - Time

Classic Cases: H.M.
Classic Cases: N.A.

- Left dorsomedial nucleus of the thalamus
- Similar pattern of deficits to H.M.
- Retrograde amnesia - 2 years
- Almost complete anterograde amnesia
- Verbal memory < visual memory (though both affected)

Classic Cases

- What functions may be left intact in cases of severe amnesia?
  - Immediate memory – can recite back several words immediately (amnestic after 5 min.)
  - Procedural memory
  - Intact memory for very remote events
  - Other facets of functioning
    - Personality
    - Intelligence

Declarative Memory

- Functional Model
  - Sensory information sent to memory processing areas (hippocampus, etc.)
  - Return pathways “store” memories back in original cortical regions
- Neural substrates for this model
  - Medial temporal lobes
  - Diencephalon (thalamus and hypothalamus)
  - Basal forebrain
Declarative Memory

- Medial Temporal Structures
  - Center around the hippocampal formation
  - Hippocampal formation includes:
    - The hippocampus proper
    - The dentate gyrus
    - The subiculum
    - The adjacent entorhinal, perirhinal, and parahippocampal cortices are important too
Declarative Memory

- **Diencephalic Structures**
  - Anterior and dorsomedial nuclei of the thalamus
  - Mammillary bodies of the hypothalamus
  - Dorsomedial thalamic nuclei and mammillary bodies are often implicated in Wernicke-Korsakoff’s disease

- **Basal Forebrain Structures**
  - A major source of cholinergic output to the cortex; projects to the medial temporal lobes
  - The basal forebrain memory structures include:
    - The nucleus basalis of Meynert
    - The substantia innominata
    - The medial septal nucleus
    - The nucleus of the diagonal band of Broca
  - Damage results in prominent anterograde amnesia and confabulation
Declarative Memory

Papez Circuit
- Major declarative memory system
- Important for consolidation

Anterior Thalamus
Cingulate Gyrus
Hippocampus
Mammillary Bodies
Fornix
Mamillothalamic Tract

Bauer, Grande, & Valenstein, 2003

Declarative Memory Organization

- Corresponds to traditional ideas of hemispheric lateralization
  - Dominant (usually left) lesions typically cause deficits in verbal memory
  - Nondominant (usually right) lesions typically lead to deficits in visual-spatial memory

Declarative Memory

- Frontal lobe contributions to memory
  - Strategy formation
  - Left: Storage; Right: Retrieval
  - Metamemory and memory monitoring
    - Knowledge of memory processes
    - Knowledge of memory contents
    - Memory for self-generated responses
    - Working memory
Working Memory

- A concept popularized by Alan Baddeley in the 1980’s
- Three components:
  - Phonological loop
  - Central executive
  - Visuo-spatial sketchpad
- Research of Patricia Goldman-Rakic:
  - Points to the dorsolateral prefrontal cortex as critical for working memory

Non-Declarative (Implicit) Memory

- Memory outside of the limbic circuitry already discussed
- Different types:
  - Implicit priming (e.g., ‘parachute’ primes par____)
  - Preserved in Korsakoff’s patients
  - Procedural and motor skill learning
    - Preserved in H.M.
    - Habit memory (conditioning)
    - Preserved in many amnesics
- Brain structures:
  - Cerebellum, basal ganglia, and motor strip

Examples of Memory Research

- Are there anatomically separate systems for different kinds of LTM (e.g., declarative versus nondeclarative)?
- How can we gather evidence of separate systems?
- Double dissociation for nondeclarative perceptual-motor tasks versus declarative verbal memory tasks

Huntington’s patients:
  (progressive deterioration of caudate nucleus of basal ganglia)
  ↑ verbal memory, ↓ perceptual-motor

Alzheimer’s patients:
  (progressive deterioration of medial temporal structures)
  ↓ perceptual-motor, ↑ verbal memory
Schachter (1988)

- Explicit vs. implicit memory
- Performance of amnesics on memory tasks

<table>
<thead>
<tr>
<th>Intact</th>
<th>Impaired</th>
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<tbody>
<tr>
<td>Delay conditioning</td>
<td>Trace conditioning</td>
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<tr>
<td>Word completion priming</td>
<td>Associative completion priming</td>
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- Some tasks are learned implicitly, i.e. they do not appear to require intact MTL structures and do not require awareness.
- Conscious awareness (likely relying on MTL structures) is necessary for some types of priming and conditioning.

Disorders Affecting Memory

- Dementias (e.g., Alzheimer’s disease)
- Toxic conditions
- Anoxia or hypoxia
- Infarcts
- Wernicke-Korsakoff’s syndrome
- Head injury/TBI
- Seizures
- Transient global amnesia
- Psychogenic amnesia

“Normal” memory loss

- Infantile amnesia – inability to recall events from the first 1-3 years of life
- Mild decline in memory function with age (contrast with dementia)
- Forgetting with the passage of time
- Loss of memory immediately after awakening from sleep
Memory Assessment
- Testing Specific Aspects of Memory
  - Evaluate adjunct processes
    - (e.g., attention)
  - Evaluate clinically relevant dimensions
    - Encoding, Storage, Retrieval
    - Immediate vs. Delayed Recall
    - Recall vs. Recognition
      - Recognition is easier than free recall for intact and brain-injured individuals
    - Material specificity (verbal vs. nonverbal)

Informal Memory Assessment
- Simple Bedside Tests of Memory
- Attention, working memory
  - e.g., digit span
  - Brief time scale, must be intact for encoding
- Immediate/delayed memory
  - Provide information and ask for it to be recalled and then again after 5-30 minutes
- Remote memory
  - Ask about verifiable personal information or about well-known events or figures in the past

Neuropsychological Tests
- Wechsler Memory Scale (WMS-III)
  - Visual, Verbal, and Global memory measures
- California Verbal Learning Test (CVLT-II)
  - Word list learning task
- Rey-Osterreith Complex Figure
  - Visual memory