**Chapter 8: Memory**

* We don't have one memory but different types of memory processes
  + Hundreds of brain areas and about 80% of cerebral cortex are implicated in memory processes
  + Brain distributes components of memory across network of locations

**Definition**

* Memory means by which we draw on past experiences in order t use information in present (Sternberg 1999)
* Term given to structures and processes involved in acquisition, storage, and subsequent retrieval of information

**Atkinson-Shiffrin multi store model of memory processes**

* ***External Stimuli (Environment)***
  + Briefly holds sensory information that has just been perceived
    - Lasts for milliseconds
      * EG. Object is briefly seen before it disappears. Once bisect us gone, still retained in sensory memory for a very short period of time
    - ***Iconic Memory***
      * Visual sensory memory of visual stimuli
        + Photographic or picture-image Emory lasting no more than 250- 500ms
    - ***Echoic memory***
      * Momentary sensory memory of auditory stimuli
        + If attention is elsewhere, sounds and words can still be recalled within 3 or 4s
    - ***Haptic memory***
      * Momentary sensory memory of tactile stimuli
        + Lasts for approximately 2s
* ***Short-term memory (working memory)***
  + Small, brief storage space for recent thoughts and experience
    - Extended as working memory by *Baddeley et al. (2002)*
  + WM maintains information available to perform tasks relative to calculus, reasoning, learning
    - An active scratchpad
      * Brain actively processes information by making sense of new input and linking it with long-term memories
    - Also works in opposite direction by processing already stored information
  + Without rehearsal (focused attention), information often fades
  + Remember for around 30s
  + **Limited capacity**
    - Hold around 5-9 items (Miller, 1956)
    - Hold around 4 items (Cowan, 2000)
      * = Memory Span
    - ***Chunking***
      * Organizing items into familiar, manageable units
        + Can occur automatically or consciously
  + **Limited interval**
    - ***Retention interval***
      * In STM, period between exposure to information and recall of that information
        + We have around 18-20s retention interval (Brown, 1958 ; Peterson & Peterson, 1959)
    - Working memory capacity varies, depending on age and other factors
      * Compared with children and older adults, young adults have greater working memory capacity
    - Working memory capacity appears to reflect intelligence levels
  + **How to improve working memory**
    - Training
    - Chunking
      * Make chinks of disparate items
    - Mnemonics
      * Memory aids
        + Especially techniques that use vivid imagery and organizational devices
    - Hierarchies
      * Grouping words and concepts, organizing, making connections
        + Mental maps
* ***Long Term Memories***
  + Unlimited capacity
  + Unlimited duration
  + **Encoding**
    - Getting information fixed into memory
    - Sometime conscious and some times unconscious
    - Giving substance and meaning to information
  + **Storage**
    - Retention of information over time
    - Active process
    - Quality and persistence of storage depends on **consolidation**
    - Sleep plays big role
      * Transfers information to storage
  + **Retrieval**
    - Getting information out of long term memory to use it
    - Goes into working memory so you can manipulate in present
  + ***Encoding***
    - Effortful processing
      * Encoding that requires attention and conscious effort
        + Eg. Learning content of course
    - Automatic processing
      * Unconscious encoding of incidental information
        + Eg. Strongly emotional events, end of movie

Things we encode automatically

Space

Where events happen

Time

Sequence of events

Frequency

How many times event happens

* + - Shallow processing
      * Encoding on basic level
      * Based on structure or appearance of words
    - Deep processing
      * Encoding **semantically** based on meaning of words
        + Tends to idle best retention
    - **How to improve encoding**
      * Ebbinghaus’ retention curve
        + The more you review, the better the encoding
      * **Relearning**
        + Relearning something gets easier and faster with number of repetitions

Also depends on how long has passed

* + - * Ebbinghaus’ forgetting curve
        + The more time has passed, the easier you have to relearn
        + **Massed practice**

Cramming

Produce speedy short term learning and feeling of confidence but they forget things quicker

* + - * + **Distributed practice**

Retain information better when encoding is distributed over time

**Spacing effect**

Tendency for distributed study or practice to yield better long term retention than is achieved through massed study or practice

* Extends to motor skills and online game performance
  + - * **Testing effect**
        + Testing does more than assess learning and memory:

Improves them

* + - * + Use deep semantic processing

You remember things better with meaningful context

* + - * **Self-reference effect**
        + Most people excel at remembering personally relevant information

Strong in members of self-individualist western cultures

Members of collectivist Eastern cultures tend to remember self-relevant and family-relevant information equally well

* + - * **Active learning**
        + Will remember material deeper, better and longer if you have to build up material yourself

Looking to find material, making connections between sources, presenting it to others, applying to real life situations, etc.

* + ***Storage***
    - Memories held in storage by web of associations, each piece of information interconnected with others
    - In absence of disorders due to trauma or neurological disease, human brain has capacity to store almost unlimited amounts of info indefinitely
    - Long term memories = not stored in just one part of brain
      * Widely distributed through cortex
    - Memories = not stored in brain like books on bookshelf
      * Must be actively reconstructed throughout various areas of brain, through encoding and retrieval processes
    - Memory storage = ongoing process of reclassification
      * Resulting from continuous changes in our neural pathways, and parallel processing of information in brains
  + ***Retrieval***
    - Recall
      * Retrieving information that was learned at earlier time
        + Fill in blank
    - Recognition
      * Identifying items previously learned
        + Multiple choice
    - We recognize more than things than we can recall
    - **Retrieval cues**
      * Stimuli that help retrieve certain memory
        + More retrieval cues, the better chance to retrieve memory
      * ***Priming***
        + Activation, often unconsciously, of particular associations in memory
      * ***Context dependent memory***
        + Putting yourself back in context where you experienced something can prime memory retrieval
        + *Encoding specificity principle*

Idea that cues and contexts specific to particular memory will be most effective in helping us recall it

* + - * ***State dependent memory***
        + What we learn in one state may be more easily recalled when we are again in that state
        + *Mood congruent memory*

Tendency to recall experiences that are consistent with one’s current good or bad mood

* + - * ***Serial position effect*** 
        + Our tendency to recall best the last (**recency effect)** and first **(primacy effect)** items in list
  + **3 types of long term memories (Tulving, 1972)**
    - ***Explicit***
      * Declarative memory
        + Semantic memory

Memory of knowledge

Words and definitions

Academic knowledge

* + - * Episodic memory
        + Memory of souvenirs

Events, experiences

* + - ***Implicit***
      * Memory of automatisms and skills
      * 3 types:
        + *Procedural*

Motor skills

* + - * + *Priming*

Automatic associations between stimuli

* + - * + Classically conditioned associations
      * Non conscious
      * Automatic
      * Implicit memory proceeds beyond consciousness and self control
        + People’s opinions cannot be changed easily if they stem from erroneous past associations
        + Memory is reconstructive
      * ***Procedural memory***
        + Some processes become automatic as they develop

Implicit knowledge of skills

Used when we speak, walk, run, grab food to bring mouth … etc.

* + - * + Knowledge built on motor experiences
        + Learned associations between movements and sensory effects
        + Procedural memory => implicit knowledge = good intuition

Ability to size up a situation and react in eye blink

Smart and quick judgements

* + - * ***Priming***
        + Activation, often unconsciously, of particular association in memory

Activating concept through its association with another concept

* + - * + **Propaganda effect**

More likely to rate statements we have read or heard before as being true, simple because we have been exposed to them before

Even if we don’t remember having been exposed to them

* + - * ***Classical conditioning***
        + Often linked to emotional reactions
        + Can be considered case of implicit memory only when there is no awareness of what is causing conditioned response

* **Memories in the brain**
  + Declarative memory
    - Frontal lobes + hippocampus
  + ***Hippocampus***
    - Loading dock where brain registers and temporarily holds elements of a to be remembered episode
      * Smell, sound, feel, location
      * Damage to hippocampus disrupts formation and recall of declarative memory
    - Sleep reactivates recent experiences stored in hippocampus and shifts them for permanent storage elsewhere in cortex
    - Supports memory consolidation
      * Neural storage of long term memory
  + ***Amygdala***
    - Emotions related memories
    - Activated when we feel emotions
    - Activated when we remember emotional memories
    - Stress hormones released by amygdala focus memory
      * Emotional arousal can sear certain events into brain, while disrupting memory for irrelevant events
        + Eg. Will remember the accident but not the people you were with
    - ***Flashbulbs memory***
      * Clear memory of an emotionally significant moment or event
  + ***Cerebellum and basal ganglia***
    - Implicit memories
      * **Cerebellum**
        + Plays key role in forming and storing implicit memories created by classical conditioning

Associations

* + - * **Basal ganglia**
        + Deep brain structure involved in motor movement

Facilitates formation of our procedural memories for skills

Receives input from cortex but doesn’t send info back to it for conscious awareness

* + ***Synaptic changes***
    - Long term potentiation
      * Given increased activity in particular pathways, neural interconnections are forming and strengthening
      * Increase in cell’s firing potential after brief, rapid stimulation
        + Neural basis for learning and memory

* **Forgetting**
  + ***Why do we forget?***
    - Remembering everything => associated with difficulty thinking abstractly
      * Generalizing, organizing, evaluating
    - Good memory is helpful, but so is ability to forget
  + ***Encoding failure***
    - Attention based
      * We remember things we pay attention to
    - Age can affect encoding efficiency
  + ***Retrieval failure***
    - Proactive interference
      * Forward acting disruptive effect of older learning on recall of new information
        + An old password prevents you from remembering new password
    - Retroactive interference
      * Backward acting disruptive effect of newer learning on recall of old information
        + New password prevents you from remembering old password
    - Interference is not positive transfer
      * Previously learned information often facilitates our learning of new information
        + Speakers of one language find it easier to learn related rather than unrelated second languages
    - Motivated forgetting
      * We succeed in forgetting unwanted neutral information
      * **Repression**
        + In psychoanalytic theory
        + Basic defence mechanism that banishes from consciousness anxiety-arousing thoughts, feelings, and memory
  + ***Memory construction errors and false memories***
    - We infer our past from stored information, plus what we later imagined, expected, saw, and heard
    - We don’t just retrieve memory, we reweave them
    - Reconsolidation
      * Process in which previously stored memories, when retrieved, are potentially altered before storing again
    - **Misinformation and imagined effects**
      * Misleading effect
        + Occurs when misleading information has corrupted one’s memory of an event
        + Visualizing (imagining) a thing/ an event and actually perceiving it activate similar brain areas

More vividly we can imagine things, more likely they are to become memories

* + - * + Emphasized importance of asking non leading questions
      * Source amnesia
        + Faulty memory for how, when, or where information was learned or imagines

Deja vu

Eerie sense that I’ve experienced this before

Cues from current situation may unconsciously trigger retrieval of an earlier experience

* + - * + Memory is reconstruction as well as reproduction

* **Extremes of memories**
  + Alzheimer’s disease
    - Neurocognitive disorder marked by neural plaques, often with onset after age 65, and entailing progressive decline in memory and (consequently) other cognitive abilities
    - Regular aerobic exercise, good diet, social connections, and keeping brain active reduces risks of alzheimer
  + Anterograde amnesia
    - Inability to form new memories
    - Automatic processing abilities remain intact
      * Can form new implicit memories
  + Retrograde amnesia
    - Inability to retrieve information from one’s past
  + Hyperthymesia syndrome
    - Superior episodic memory
  + Savant syndrome
    - Condition in which person otherwise limited in mental ability has an exceptional skill
      * Computer, math, drawing, music, navigation, memory …
    - About half cases are associated with autism