Memory account for time and defines our lives - in large part we are what we remember.

**Memory** - learning that has persisted over time; information that has been acquired, stored and can be retrieved

**Memory Models**

*Encoding* - process of getting information into our brains

*Storage* - process of retaining information

*Retrieval* - process of later getting information out

*Parallel Processing* - our dual track brains process many things at once (some of them unconsciously)
**Connectionism** - an information processing model that explains the complex, simultaneous processing involved in *memories as products of interconnected neural networks*.

- Specific memories arise from particular activation patterns within networks

**Atkinson & Shiffrin 3 Stage Model**

*Sensory Memory* - first stage where we record to be remembered information as a fleeting sensory memory

*Short Term Memory* - information is processed and encoded through rehearsal (*repeating it over and over to ensure encoding*)

*Long Term Memory* - information is moved here for later retrieval
The 3 Stage Model has been updated to include newer concepts:

- Working Memory
- Automatic Processing

**Working Memory**

- Short term memory is an active desktop that processes information before sending it to long term memory...working memory better describes what used to be called short term memory

- Context and Experience will guide our interpretation and encoding

*Working Memory* focuses on conscious active processing of incoming auditory and visual spatial information, and of information retrieved from long term memory

- a Central Executive handles the focused processing that occurs here
Automatic Processing

A modified three-stage processing model of memory
**Dual Track Mind: Effortful Versus Automatic Processing**

**Explicit Memories**- facts and experiences we can consciously know and declare (also called *Declarative Memories*)

- Encoded through conscious, **Effortful Processing**

**Implicit Memories**- information that skips the conscious encoding track and goes right into storage (also called *Nondeclarative Memories*)

- Encoded through subconscious, **Automatic Processing**
**Effortful Processing & Explicit Memories**

*Skills such as driving, texting, speaking and reading initially require effort, but then become automatic processes*

Sensory Memory feeds our active working memory, recording momentary images of scenes or echoes of sounds

Iconic Memory momentary sensory memory of visual stimuli (photo or image) lasting no more than a few tenths of a second

Echoic Memory momentary sensory memory of auditory stimuli, if attention is elsewhere, sounds and words can still be recalled within 3 to 4 seconds

**Capacity of our Short Term Memory**
- Short term memory has a capacity of about 7 times, plus or minus 2
- Capacity varies depending on age, intelligence and other factors

**Effortful Processing Strategies**

Chunking organizing into familiar, manageable units

Mnemonics memory aids, especially those techniques that use vivid imagery and organizational devices  ROYGBIV

Hierarchies broad topics, organizing into subtopics
Effortful processing and explicit memories

- Sensory memory
- Capacity of short-term and working memory
- Effortful processing strategies
  - Chunking
  - Mnemonics
  - Hierarchies
Automatic Processing & Implicit Memories

Vision, thinking, and memory are not single abilities; the information we take in and process is split into different components for separate and simultaneous processing.

Procedural Memory
- implicit memory for automatic skills (how to ride a bike) and classically conditioned associations

Without conscious effort you automatically process information about:

1) **Space** - when studying you encode place on the page, where graphics/topics occur

2) **Time** - during the day you encode sequence of events; allows you to track your steps

3) **Frequency** - records how many times things happen
Distributed Practice

- Cramming can provide short term gains, but distributing your practice over time results in long term recall **known as the SPACING EFFECT**

SO READING OVER YOUR NOTES FOR 5 MINUTES A DAY WILL PRODUCE BETTER RESULTS THAN JUST STUDYING THE NIGHT BEFORE A TEST....

Levels of Processing

Shallow Processing- encodes on a very basic level, such as letters or sounds

Deep Processing- encodes semantically, based on meaning of the word
FISHING POLE
UMBRELLA
Volleyball
MATCHES
BOOTS
FOOD
MONEY
CLOTHES
CELL PHONE
JACKET
KNIFE
WATER
COOKING POT
DUCT TAPE
Module 32 - Memory Storage and Retrieval

Long term memory storage is limitless

Memory encoding, storage and retrieval involve many parts of our brains interacting together

**EXPLICIT MEMORY SYSTEM: THE FRONTAL LOBES & HIPPOCAMPUS**

**Frontal Lobe**

- When you begin to retrieve past experiences, many brain regions send input to your frontal lobe for working memory processing  
  *each half of the frontal lobe processes different types of memories*

  **Left Frontal Lobe**  ex. recalling a password and holding in working memory
  **Right Frontal Lobe**  ex. recalling a visual party scene
**Hippocampus**

- Temporal lobe neural center located in the limbic system

- Essentially your brain’s “save button” for explicit memories

- New explicit memories of names, images and events are laid via the hippocampus

- Sub regions of hippocampus serve different functions: associate names with faces; spatial mnemonics; spatial memories

- Hippocampus does not store memories permanently, they are held there then shifted to permanent storage. *SLEEP SUPPORTS MEMORY CONSOLIDATION*
**Implicit Memory System: The Cerebellum and Basal Ganglia**

- Even when parts of brain are damaged that process explicit *(effortful processing)* the brain is still able to lay implicit memories *(automatic processing)*  ex. Dr. shaking hand with patient
- Classical Conditioning can still occur

- Damage to the **Cerebellum** can make implicit memories *(classical conditioning situations)* impossible to process

- **Basil Ganglia** is a deep brain structure involved in motor movement
- Receives input from the cortex but does not send information back for your conscious awareness

- The work of these two brain structures explains why learning from our infancy extends into adulthood.
- **Infantile Amnesia**—blank conscious memory our first three years
- *We index much of our explicit memories using words that children under 3 haven't formed*
- **Hippocampus** is one of the last brain structures to mature
The Amygdala, Emotions and Memory

- Emotions influence memory processing; releases stress hormones that signal to the amygdala (limbic system cluster) to initiate memory.
- Results in signal to frontal lobe and basil ganglia to boost brain activity in memory forming areas.

THE RESULT: Emotional arousal can sear certain events into the brain.

Memory serves to predict the future and alert us to potential danger.

- Weaker emotions = weaker memories

- **Flashbulb Memories** – a clear memory of an emotionally significant moment or event

  * September 11th
  * Assassination of JFK
  * Birth of a child
**Synaptic Changes**

- Focus has been on synaptic meeting places where neurotransmitters communicate messages

- California Sea Slug, with only 20,000 large accessible nerve cells, was used to test and observe activity in the synapses

- Findings: Serotonin = efficient signal transmission; results lasted for days or weeks in people...allowing people to send messages with less prompting and more connections between nerve cells

**Long Term Potentiation:** increase in a cell’s firing after brief, rapid to stimulation. Believed to be a basis for learning and memory.
Memory processing

Our two memory systems

Automatic

Implicit memories (Nondeclarative) Without conscious recall

Processed in cerebellum and basal ganglia

- Space, time, frequency (where you ate dinner yesterday)
- Motor and cognitive skills (riding a bike)
- Classical conditioning (reaction to dentist's office)

Effortful

Explicit memories (Declarative) With conscious recall

Processed in hippocampus and frontal lobes

- Facts and general knowledge (this module's concepts)
- Personally experienced events (family holidays)
Retrieval: Getting Information Out

**Recall** retrieving information that is not currently in your conscious awareness but that was learned at an earlier time

**Recognition** identifying times previous learned (multiple choice tests)

**Relearning** learning something more quickly when you learn it a second time or later on (reviewing for final exam)

**Retrieval Cues**

**Priming** – activation of particular associations related to a memory
**Context Dependent Memory** putting your self, visually or mentally, in the place the event occurred.

**State Dependent Memory** memories made in various states (drunk or sober) may be more easily recalled when in that state
- emotions that accompany good and bad events become retrieval cues
- depression sours memories by priming negative associations

**Serial Position Effect** tendency to recall best the last (recency effect) and first items (primary effect)
Module 33: Forgetting

Forgetting and the Two Track Mind

There are various types of forgetting

- **Anterograde Amnesia** - ability to recall the past but not able to form new memories

- **Retrograde Amnesia** - inability to recall the past information

Patients with these types of amnesia have exhibited the ability to learn things without any conscious knowledge that they learned such things

  Explicit (Effortful) can be damaged and Implicit (Automatic; classical conditioning) can still occur

Encoding Failure

- Much of what we sense we never notice, fail to encode and never remember
- Age affect encoding efficiency
**Storage Decay**

Ebbinghaus - learned lists of nonsense syllables and measured how much he retains when relearning each list (from 20 minutes later up to 30 days later)

Forgetting Curve *memory for novel information fades quickly then levels out*

**Retrieval Failure**

Retrieval can be affected by age, **interference** or motivated forgetting (purposeful forgetting)

**Interference**

Colliding of old and new learning in your memory storage

*Proactive (forward acting) interference* - occurs when new learning disrupts recall new information

*Retroactive (backward acting) interference* - when new learning disrupts old information

Information presented in the hour before sleep is protected from retroactive interference because the opportunity for interfering events is minimized

Information presented in your sleep is registered by the ears, but none is committed to memory

**Positive Transfer** - old information serving as a facilitator of new learning

**Motivated Forgetting**

Sigmund Freud’s theory that we repress painful or unacceptable memories to protect our self concept and minimize anxiety
Sensory memory
The senses momentarily register amazing detail.

Working/short-term memory
A few items are both noticed and encoded.

Long-term storage
Some items are altered or lost.

Retrieval from long-term memory
Depending on interference, retrieval cues, moods, and motives, some things get retrieved, some don't.
Memory Construction Errors

Misinformation
- incorporating misleading information into one’s memory of an event

- so powerful it can influence later attitudes and behaviors

- just hearing a vivid retelling of an event can implant false memories

- repeatedly imagining non existent events and actions can create false memories

- altered photos can produce imagination inflation

Source Amnesia
- inability to recognize the source of the memory (Piaget and the kidnapping story)

Deja vu seems to be a familiarity (temporal lobe processing) before we consciously remember the details (hippocampus and frontal lobe processing). When these regions are out of sync, we can get a strange sense of knowing with out awareness of how we know
Children’s Eyewitness Recall

- susceptible to the misinformation effect; if questioned in neutral words, can accurately recall events and people involved

- debate focuses on whether most memories of abuse are repressed and can be recovered during therapy (memory work techniques using leading questions and hypnosis)

Psychologists agree:

- sexual abuse happens
- injustice happens
- forgetting happens
- recovered memories are commonplace
- memories before the age of 3 are unreliable
- memories recovered under hypnosis or drugs are unreliable
- memories, whether real or false, can be emotionally upsetting

Improving Memory

- study repeatedly, make material meaningful, activate retrieval cues, mnemonics devices, minimize interference, sleep more, test yourself for retrieval
Module 34 - Thinking, Concepts and Creativity

THINKING AND CONCEPTS

**Cognition** - all the mental activities associated with thinking, knowing, remembering and communicating

**Concept** - mental groupings of similar objects, events, ideas and people

*when you think of a bird you think of types of birds, bird migration, bird habitats - all related to birds

**Prototype** - mental image or best example of a category

CREATIVITY

**Creativity** - ability to produce novel and valuable ideas

**Convergent Thinking** - narrows the available problem solutions to determine the single best solution

**Divergent Thinking** - expands the number of possible problem solutions (creative thinking that diverges in different directions)
Five Components of Creativity

- **Expertise**  
a well understood base of knowledge

- **Imaginative Thinking**  
ability to see things in a novel way

- ** Venturesome Personality**  
seeks new experiences

- **Intrinsic Motivation**  
driven by interest and challenge

- **Creative Environment**  
sparks, supports and refines creative ideas
Module 35 - Solving Problems and Making Decisions

**PROBLEM SOLVING: STRATEGIES & OBSTACLES**

*Algorithm* - methodical, logical rule or procedure that guarantees solving a particular problem

*Heuristic* - simple thinking strategy that often allows us to make judgements and solve problems efficiently

*Insight* - sudden realization of a problem’s solution; contrasts with strategy based solutions

*Confirmation Bias* - tendency to search for information that supports our preconceptions and to ignore or distort contradictory evidence

*Mental Set* - tendency to approach a problem in one particular way
FORMING GOOD and BAD DECISIONS and JUDGEMENT

*Intuition* - effortless, immediate, automatic feeling or thought, as contrasted with explicit, conscious reasoning

**THE REPRESENTATIVE HEURISTIC**

- judging the likelihood of things in terms of how well they seem to represent, or match, particular prototype; may lead us to ignore other relevant information

**THE AVAILABILITY HEURISTIC**

- estimating the likelihood of events based on their availability in memory; if instances come readily to mind we presume such events are common

**OVERCONFIDENCE**

- tendency to be more confident than correct, to overestimate the accuracy of our beliefs and judgements
BELIEF PERSEVERANCE
- clinging to one’s initial conceptions after the basis on which they were formed has been discredited

EFFECTS OF FRAMING
- the way an issue is posed; how an issue is framed can significantly affect decisions and judgement

PERILS AND POWERS OF INTUITION
- Intuition is huge
- Intuition is usually adaptive
- Intuition is recognition born of experience
Module 36 - Thinking and Language

**Language** - our spoken, written or signed words and the ways we combine them to communicate meaning.

**LANGUAGE STRUCTURE**

- **Phonemes** - smallest distinctive sound unit
- **Morphemes** - smallest unit that carries meaning, may be a word or a part of a word
- **Grammar** - system of rules that enables us to communicate with, and understand others.

**LANGUAGE DEVELOPMENT**

- **Receptive Language** - ability to understand what is said to them and about them
- **Productive Language** - ability to produce words, recognize sounds and respond to words
- **Babbling Stage**: beginning around 4 months; utters various sounds
- **One Word Stage**: from about 1 to 2 years old
- **Two Word Stage**: from 2 years old
- **Telegraphic Speech**: early speech stage in which a child speaks like a telegram; using mainly nouns and verbs e.g., go car
Universal Grammar - all languages do share some basic elements (nouns, verbs, adjectives)
- most all languages start speaking in nouns
  - Noam Chomsky

Statistical Learning - ability to learn simple sentence structure; patterns, rules, syllables

Critical Periods - period of language acquisition; by age 7 if language has not been spoken or exposed to children, there ability to master any language is lost

THE BRAIN AND LANGUAGE

Aphasia - impairment of language, usually caused by left-hemisphere damage either to Broca’s (speaking) or Wernicke’s (understanding) areas

Broca’s Area - Left frontal lobe; controls language and expression; usually in the left hemisphere; directs muscle movements involved in speech

Wernicke’s Area - Left temporal lobe; controls language reception; involved in language comprehension and expression
Language functions are distributed across the brain

- IN PROCESSING LANGUAGE, as in other forms of information processing: the brain operates by dividing its mental functions—speaking, perceiving, thinking, remembering—into sub functions.
LANGUAGE and THOUGHT

Linguistic Determinism - Benjamin Whorf’s hypothesis that language determines the way we think

- we routinely have symbolized thoughts (wordless, imageless thoughts)
- English vocabulary is rich with self-focused emotions such as anger
- Japanese vocabulary has more interpersonal words such as sympathy
- THESE CHANGES IN VOCABULARY RESULT IN A CHANGE IN THE SENSE OF SELF
- To expand you language gives you the ability to expand your thinking

Thinking in Images – we often think in images; helpful in most cases for committing learning to memory