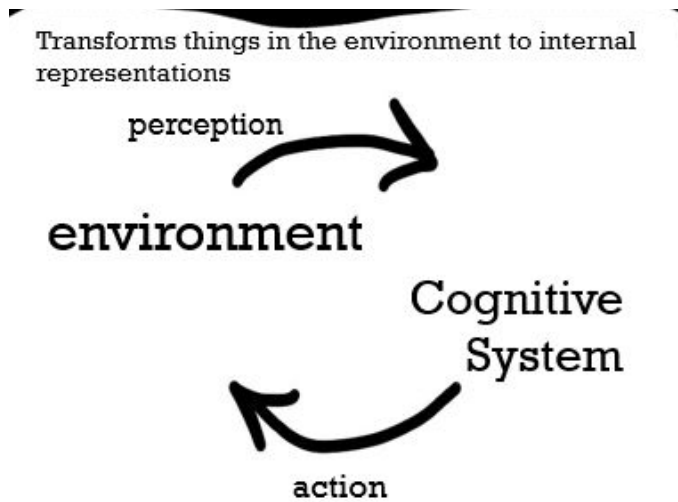
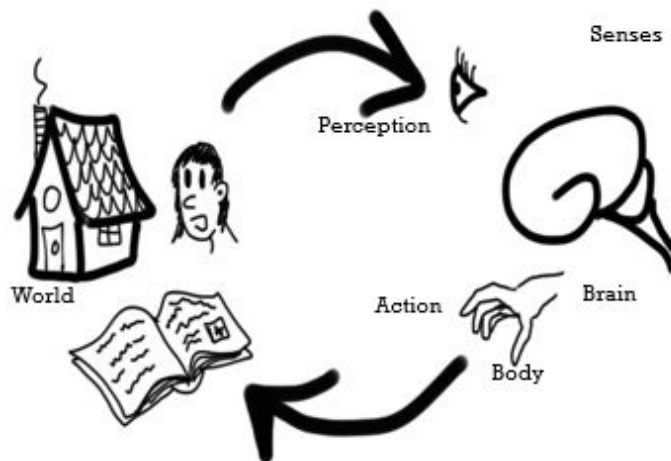


## 2018-01-11 Learning memory representations

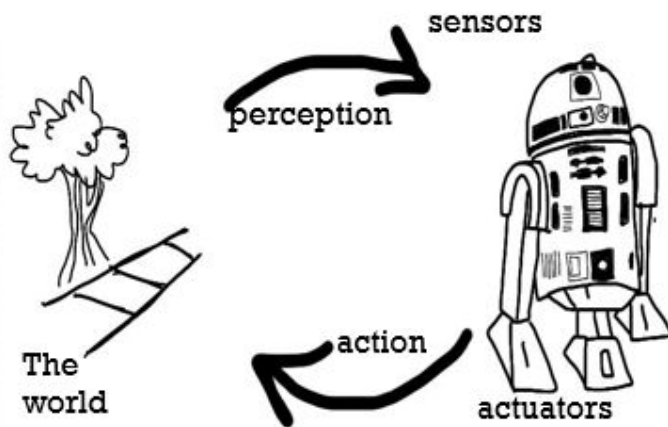
### Cognitive Systems



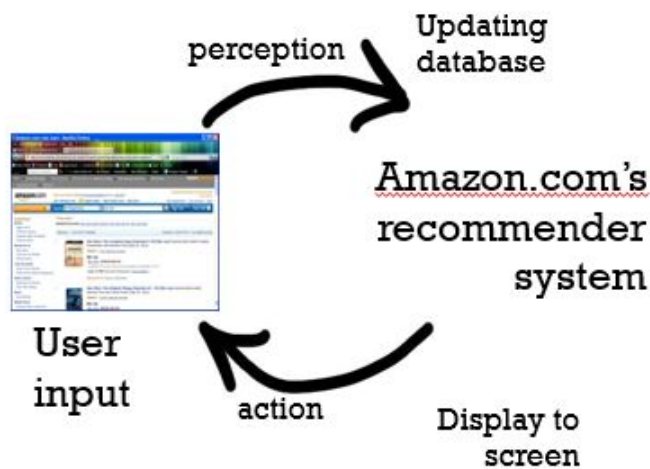
- Turns desires to act into physical changes in the environment
- Transforms things in the environment to internal representations
- Environment -> perception -> cognitive system -> action
- Turns desires to act into physical changes in the environment



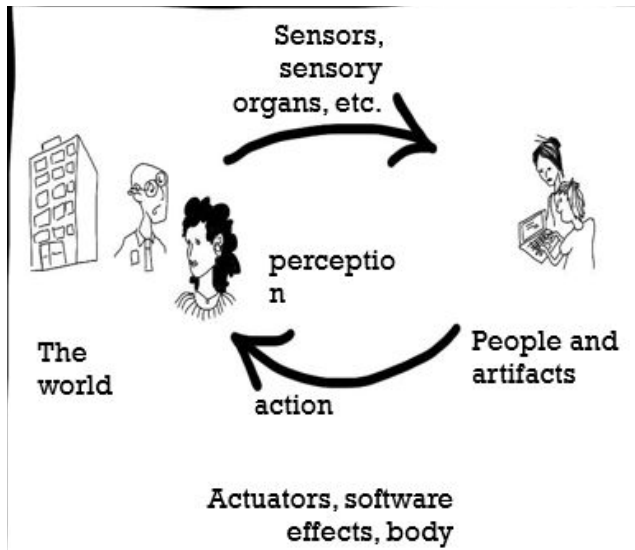
- 
- How the animal mind works (abridged)
- World (environment) -> perception (senses) -> cognitive system (brain) -> action (body/hand)



- 
- Robotics
- The world -> perception (sensors) -> cognitive system -> action using actuators (An **actuator** is a component of a machine that is responsible for moving and controlling a mechanism or system)

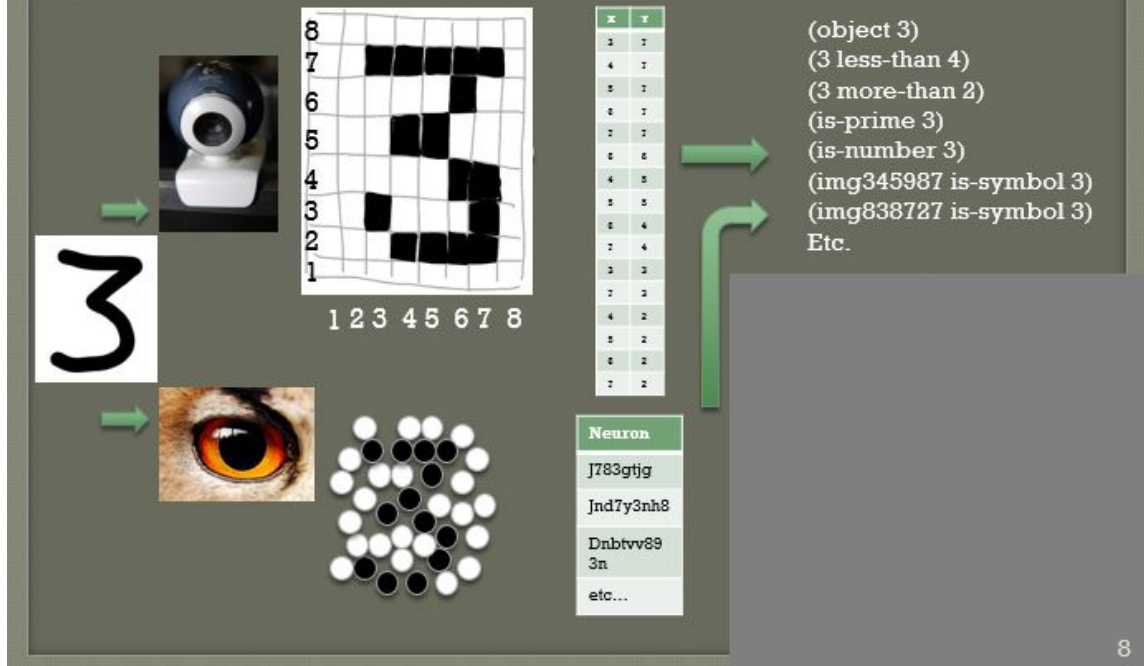


- 
- Disembodied Software
- User input (world) -> perception (updating db) -> amazon's recommender system -> action display to screen



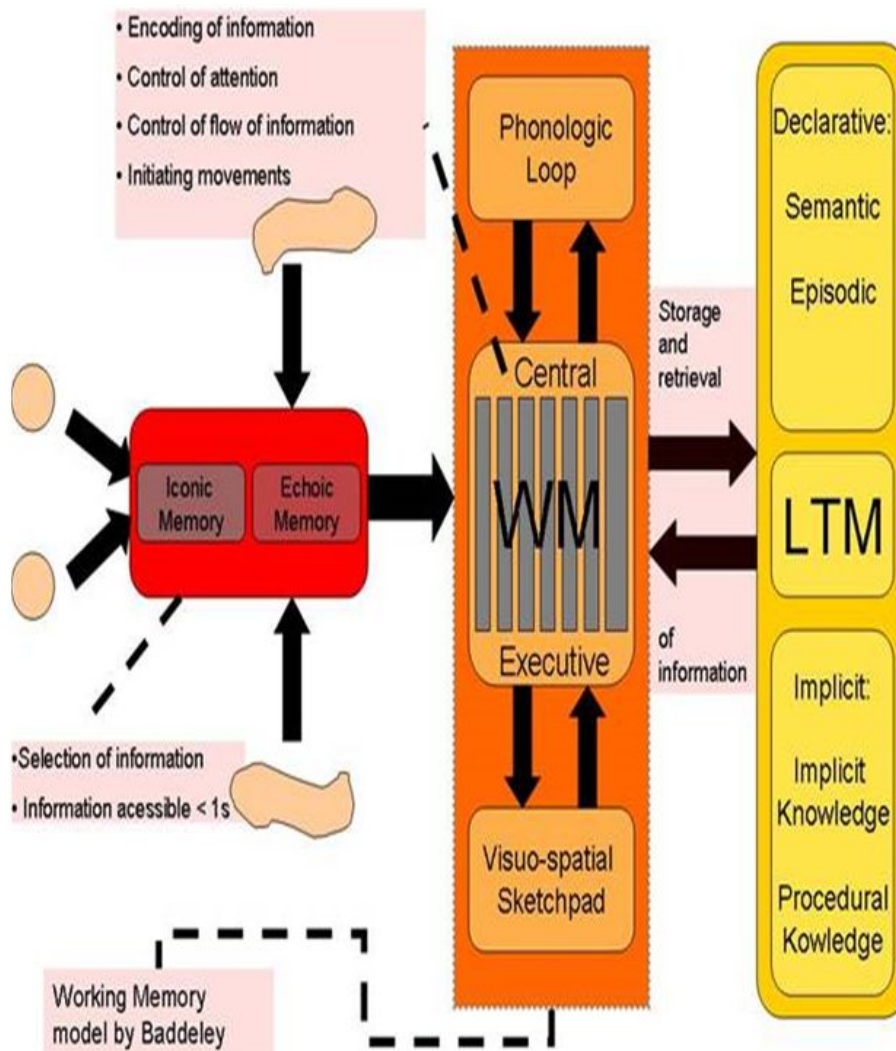
- 
- Distributed cognition
- The world -> perception (sensors/sensory organs), distributed cognitive system (people and artifacts) -> action (actuators, software effects, body)
- What is a description of a distributed cognitive system and its environment (DCS/environment)
  - A child comprehending TV/ the television broadcast
  - A student using a campus map to get to a classroom/a map
  - **A construction worker using a blueprint to make a house/the materials and house**
- Correct answer is construction worker/house
- Cognition is manipulation of representations

# Cognition is Manipulation of Representations



- 
- Representations are stored in memory
- Animal
  - Brain, long-term memory, short-term memory
- Software
  - Databases, symbols
- Distributed system
  - Paper, brain, disk, environmental manipulation
- We can describe memory as many things in cognition at different levels of explanation
  - In animals including humans we can describe memory's location, biologically
  - We can also describe it functionally (eg long-term/short term)
- Human memory of fact and perceptions (not skills)
- Sensory Memory
  - Sensory memory is like a scratch pad (for vision) or a bit of recording tape (for hearing), that can be overwritten with new things. It is re-written every few seconds by new perceptions

- Example you are writing at the computer someone says something, you finish typing a few seconds later and respond without really understanding what they said. Won't work if you wait more than a few seconds
- Short term memory
  - Short term is a temporary store. Some things from it end up becoming long term memories
- Long term memory
  - Probably stored here forever, though we might have trouble retrieving it
- Sensory memory -> short term memory -> long term memory



- Working Memory is Baddeley's refined theory of short term memory.
  - The working memory for facts is commonly thought to have 5-9 slots, one for each "chunk."

- A chunk is a bit of working memory. The letters M, L, K, J, F, K each might be a chunk, but if you noticed that they were initials (MLK, JFK) then you could store them as two chunks.
- Some research suggests that there are more like four slots in WM.
- Baddeley thinks there are separate working memories for audition (hearing) and vision.
- Some people think that WM is like what we said short term memory—that is, a temporary buffer that holds it before it goes into LTM. This is the gateway model.
- The workspace model thinks that WM is a separate buffer from LTM. Things get shuffled in and out of it as the task demands. That is, it holds copies of information in LTM.
- The unitary model holds that WM is simply the activated parts of LTM.
- Biology of human memory
  - We don't know much about where declarative long term memories are stored
  - The hippocampus appears to be important for transforming short term into long term memories
  - Procedural memory appears to happen in the cerebellum, the basal ganglia and the motor cortex.
- Computer memory vs software memory
  - Software memory
    - Hash tables, schemata, frames, scripts, logical sentences, bitmaps, activation patterns (to a cognitive scientist this is interesting stuff)
  - Computer memory
    - Disk, flash memory (but who cares this description is not at the cognitive level)
- For memory most cognitive science is interested in the structure of knowledge at the cognitive level. Its the level above the implementation level (e.g neurons or disk)
- Memory in distributed systems
  - Books, brains, fingers, notes, arrows/signs
- Learning is changing memory with the purpose of preparing a system for better action in the future
- Habituation
  - Diminution of a behavioural response with repeated stimulation.
  - The first time you hear a loud noise, you might jump but afterwards you stop jumping
  - Clothes on the body

## Which is an example of habituation?

- ☒ The more someone pokes you, the more it bugs you.
- ☐ At first you get very hungry when you skip lunch, but after a few weeks you aren't.
- ☐ After living in the old house for a while, you learn where to avoid stepping so that the floorboards don't creak.
- ☐ After tasting lots of Indian food, you come to expect it to be spicy.

Correct answer B

- Sensitization
  - When a behavioural response is amplified by repeated exposure to a stimulus
  - At first you can barely feel a vibrating phone in your pocket, eventually become very sensitive to it
- Classical conditioning
  - Learning to associate two previously unrelated stimuli
  - Typically means you learn to behave similarly to stimulus B as you do to stimulus A
  - Pavlov's dogs

## Which is an example of classical conditioning?

- A child learns not to touch the stove because it burns her.
- After hearing the same joke a few times, you stop laughing at it.
- You learn that the capitol of France is Paris in a textbook.
- You eat a new food and then get sick because of the flu. However, you develop a dislike for the food and feel nauseated whenever you smell it.

21 Correct

answer D

- Kinds of operant conditioning
  - Positive reinforcement
    - Someone smiles at you when you hold the door for him/her
  - Negative reinforcement
    - A baby screams until you give them candy then she stops (Adult learning NR, baby learning PR)
  - Positive punishment
    - You get burned by touching the hood of a car in the sun
  - Negative punishment
    - Your parents cut off your allowance because you lied

	Adding feedback	Removing feedback
Encouraging behaviour	Positive reinforcement	Negative reinforcement
Diminishing behaviour	Positive punishment	Negative punishment

- Making a behaviour more or less likely to happen in the presence of a stimulus depending on reward, punishment or taking away a reward or aversive stimulus
- Positive = present, Negative = remove, Reinforce make more likely, punish make less likely
- Practice



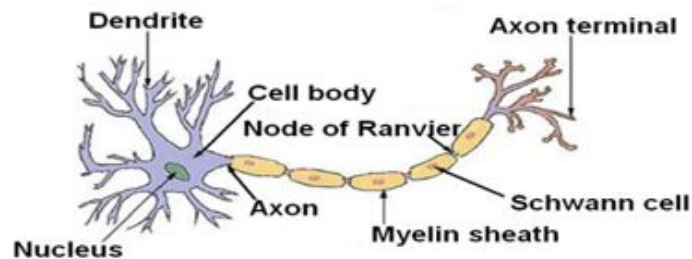
- Practice involves doing something over and over and learning how to do it better. It uses reinforcement and punishment to hone the skill
- Play is theorized to be a form of practice for future events (chasing, fighting, caretaking, manipulating objects)
- Motor skills (moving body) gets easier because of automatization
  - It becomes instinct, fast, unconscious and automatic, tying shoes for example
- Imprinting
  - A time-sensitive learning in an animal that is insensitive to behavioural outcomes
    - Eg a goose learning who its mother is happens 13-16 after hatching
- Observational Learning
  - Learning that happens by observing another individual doing something
  - Copying michael jackson dance moves on youtube
  - Much of cultural learning is observational but some is explicitly taught (enculturation)
- Testimony
  - When someone tells you something, eg how to start a web browser or that orcas are mammals
  - Can be read or heard aloud
  - We also get facts by figuring them out but this is better described as “reasoning”, “inference” than “learning”
- Learning over human history
  - Genetic
    - When environments change very slowly
  - Cultural Learning
    - When environments change relatively quickly
    - Content Bias
      - Imitate the best idea
    - Prestige bias
      - Imitate the most successful
    - Conformist bias
      - Imitate the most common ways of doing things
  - Individual learning (figuring out for yourself Baldwin effect)
    - When environment changes very rapidly there is reduced cultural transmission
    - What you are predisposed to learn from birth
  - Of course cultures are subject to natural selection as well. Evolution is substrate-neutral

## 2018-01-16 The cognitive level

- Ways to explain: we will use learning as a running example
- Cognitive science specializes in a particular level of explanation. The cognitive level.
- In terms of abstraction
  - Anthropology at top, physics at the bottom
- Learning at the sociological level: fujian food taboos
  - Food taboos for pregnant and lactating women in fujian selectively target the most toxic marine fish. Reduce chance of woman/baby dying
  - Culture learning: people who didn't eat the fish had more kids surviving and it passed on
- Learning at the psychological level: eating some fish can make you sick
- Learning at the cognitive level Adjusting parameters on production
  - One cognitive theory is that the mind does what it does by firing little information processing rules called "productions"
  - IF you are hungry AND you see a blue fish THEN eat it
  - When something good or bad happens the productions used to get to that state of affairs are made more less likely to fire in the future
  - Note that the cognitive level deals with information and how it is processed
- Learning at the biological level: synaptic changes
  - Neural networks, neurons that fire together wire together. So if you have some neurons representing the concept of poison and other presenting the eating of a certain kind of fish, then those neurons will be more likely to co-activate in the future

# Learning at the Biological Level: Synaptic Changes

## Structure of a Typical Neuron



Synapses are the spaces between neurons, where communication happens. Synapses get more efficient with repeated use. This is "Hebb Theory."

Neurons that fire together, wire together. This is how associations are learned.

So, if you have some neurons representing the concept of poison, and others representing the eating of a certain kind of fish, then those neurons will be more likely to co-activate in the future.

- 
- Learning at the chemical level:
  - Synaptic changes in taste receptors to tolerate bitter foods
  - Children often vomit when eating some bitter foods that adults enjoy
  - Learning to like coffee and brussels sprouts
- Learning at the physical level
  - Not a good level of description for learning. Yet
  - Some people believe that quantum effects are directly related to consciousness (most people don't take seriously)
- How do we know if a level is legit
  - If it can successfully make casual predictions using the ontology of that level
  - Ontopology a set of things said to exist
- Why are scholars often dismissive of levels above the one they work at?
  - Because they believe that the regularities found at higher level are or will be deducible from lower-level regularities
  - The is one form of reductionism (the practice of analyzing and describing a complex phenomenon in terms of phenomena that are held to represent a simpler or more fundamental level, especially when this is said to provide a sufficient explanation)

- Why do we need the sociological level
  - Certain group behavior phenomena such as group going on strike are difficult to explain with individual psychology
- Why do we need the psychological level
  - We need it in addition to the sociological level because some behaviors are not heavily influenced by their social context (baby face recognition: baby when born if given two things to look at face/spoon will look at the face)
  - We need it in addition to the cognitive level because we need a place for non causal statistical models (nutrition influences IQ we need to eat protein)
- Why do we need the cognitive level
  - Because the explanation of certain behaviours without the language of information processing is too vague (ie how people do multiplication)
  - We need it in addition to the biological level because mental states and processes are defined functionally not anatomically
    - You and I are both happy to be here. Even though our brain states are quite different
    - Bold button different ways to store, but hitting bold button is the same information
    - Know lyrics of call me maybe, but neurons for everyone different
    - Seeing a play vs reading the play. Can talk about them at the information level not physical manifestation
  - Two ways of learning how to add regular way and abacus. If asked to do mental calculations different types of errors
- Why do we need the biological level
  - Because sometimes the biological structure influences behavior in ways that the information processing perspective cannot explain. Eg number/colour synesthesia due to co-located gyri (some people if you write a 4 will see a glow around the color) Can be explained because Color/numbers are physically close in the brain
  - We need it in addition to the chemical level because certain brain structures appear to be used for particular things Eg hippocampus and short-term memory
  - Dopamine affects a lot of things like depression, motor control and understanding patterns cant understand without knowing biology
- Why do we need the chemical level
  - Because chemicals can affect behavior (Cant talk about drug effects without talking about the drug which is made of chemicals)

- Because physics doesn't tell us much of anything about human behaviour
- Proximate and Ultimate Descriptions in Cognitive Science
  - Proximate explanation: we eat because it satisfies our hunger and food tastes good
  - Ultimate explanation: we eat because we need nutrition to stay alive
  - Sex, proximate: feels good, ultimate: reproduce
- The cognitive level is the information processing level
  - Cognitive science prefers descriptions of information and how it is represented and change
  - For example cognitive scientists have theorized that individual memories have activation levels that determine how easily they can be retrieved from memory
  - We accept the idea of an activation level if it helps us predict behaviour. We also like that if we find some biological basis for it
  - Another way to put this is that cognitive scientists prefer to describe the workings of a mind at a level so detailed that one could get a computer to execute the task in the same way
  - The metaphor for cognitive science is not that the mind is a computer but a computer program
  - Programs are information processing instructions and computers have all kinds of hardware that has nothing to do with minds or brains and the nature of this hardware changes over time and across computers

## **2018-01-18 The fields that compose cognitive science**

- Historically core fields
  - Psychology
  - Philosophy
  - Computer science
  - Linguistics
- Contemporary core fields
  - Neuroscience
- Secondary fields
  - Education
  - Anthropology
- Psychology characterized by
  - Subject matter: natural minds, mostly human
  - Broadly interested in cognitive functioning even when it is erroneous

- Methods: laboratory experimentation, statistical analysis and computer cognitive modeling
- Subfields
  - Cognitive psychology
    - Broad field of basic research in human internal mental process
    - Usually experiments with human beings and doing stats on the results
  - Human factors/ Human computer interactions
    - How people psychology interact with artifacts such as UI/websites
  - Evolutionary psychology
    - How our evolutionary history has made our minds what they are
    - Psycholinguistics
      - Studying language with experiments
    - Comparative psychology
      - Animal cognition sometimes comparing it to human
- Critiques
  - Not enough model building
    - You can't play 20 questions with nature and win
  - Dustbowl empiricism
    - Not enough theory there are no theoretical psychologists
  - Methodologically limited
    - Cognitive science is possible because psychology wont innovate to embrace the methods of other fields
  - They underestimate the complexity of language
- Philosophy characterized by
  - Subject matter: usually big questions, what our concepts mean, otherwise quite broad
  - Methods thinking and writing
    - Thought experiments (soy sauce on broccoli or soy sauce on mango)
    - Conceptual analysis (figuring out the difference between the words we use guilt vs shame)
    - Argumentation (if this is true and this is true then this must be true)
    - Theorizing from evidence from other fields and commonsense observations
- Subfields
  - Philosophy of mind
    - Can machines be conscious
    - Functionalism vs identity theory

- Qualia (experience of what you have had)
    - Which animal feels pain
  - Philosophy of science
    - How should science be practiced, how is science practiced, philosophy of psychology ( the science), what mental categories are scientifically legitimate
  - Philosophy of language
    - How do words connect to meanings? How can a word refer to something that does not exist
- Critiques
  - They don't pay enough attention to empirical study
  - They sometimes think that the existence of a word implies the existence of its intended referent
  - They are concerned with too many unimportant problems
- Computer science characterized by
  - Subject matter: how mental processes can work on machines, and how computers can effectively interact with humans
  - Methods: building and testing computer programs
- Subfields:
  - AI
    - Building mental processes with computer programs, to understand and create mental systems
  - HCI
    - To design computer interfaces that humans can effectively use
- Critiques
  - Insufficiently concerned with natural intelligence
    - AI researchers usually don't care if their programs work the same way that people do, even those doing psychology AI don't know enough about empirical findings or don't try to build in the mistakes people make
  - They are overly optimistic about the future of AI
- Linguistics Characterized by
  - Subject matter: human spoken or signed natural language
  - NOT computer or animal languages, NOT (for the most part) written language
  - Methods: sound analysis, grammar creation, corpus analysis (corpus = body of text)

- Most cognitive science subfields are defined by their methods but linguistics is strongly characterized by both its subject matter and its methods
- Use its when its possessive “Every dog has its day” Use it’s when you mean it is
- Subfields
  - Phonology
    - How sounds are organized and used in language
  - Morphology
    - How sound and meaning interact in words (past tense etc)
  - Syntax
    - How sentences may be put together in a language
  - Semantics
    - Meaning in language
  - Pragmatics
    - How sentences interact with context to change meaning “how are you” vs “do you have the time”
- Critiques
  - They build models of language and then dont know what to do with them
  - They are not familiar with nor do they try to interact with other findings about the mind
  - They only concern themselves with one part of cognition
- Cognitive Neuroscience characterized by
  - Subject matter: how the brain processes information and creates cognitive processes. The biological functions of mental phenomena
  - Methods: neuroimaging (taking photos of the brain), single cell recording (studying one cell), anatomical observations (mapping how the brain works), computer modeling (modeling how neurons interact structure of the brain), Genetic analysis (how genes affect how the brain is forced)
  - Overlaps with biological and physiological psychology, neuropsychology and the rest of neuroscience
- Neuroscience critiques
  - Underestimate the complexity of language and other thought processes
  - Completely unable to shed light on many of the processes everyone else is interested in
  - They tend to be dismissive of other approaches or reductionist
  - Lean too far toward nature on the nature/nurture debate
- Education

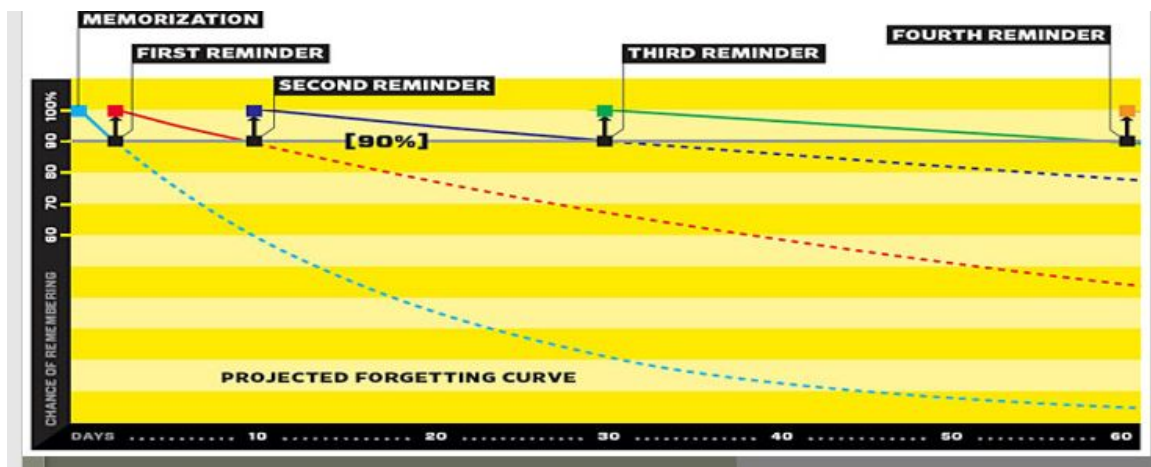


- Subject: how people learn, and how we can design education to help them effectively do it
- Methods: naturalistic observation of case studies, empirical studies
- Teacher effect: good teacher is way better than a bad teacher swamps most other effects makes studies hard to do
- Critiques
  - Case studies are worthless or close to it
  - It's too applied and not telling us enough about basic cognitive processes
  - The controlled studies are poorly done (to be fair hard and expensive)
  - They only deal with one part of cognition
- Cognitive anthropology characterized by
  - Subject matter: social organization, humana culture, enculturation, cultural change and transmission, shared knowledge, distributed cognition, situated cognition
  - Methods
    - Field work, ethnographic observation and interviewing. Emphasis on qualitative
  - Anthropology includes things like archeology
  - Cultural anthropology includes cognitive
- Critiques
  - Tend to lean too far on the nurture side of the nature/nurture debate
  - Research is too qualitative
  - Research is too expensive
  - Not general enough
  - Splitters (delight in finding unique and rare exceptions to generalizations) rather than lumps (try to put everything in a few categories and emphasize similarities across different systems)
- So what is cognitive science
  - Subject matter: study of minds and thinking especially at the information processing level
  - Methods: applies methodologies form multiple disciplines to multiple problems from those disciplines
- What is a cognitive scientist
  - A cognitive scientist is any scholarly practitioner studying minds from one of the associated sub-fields. According to this definition, a philosopher working on philosophy of mind problems would be considered a cognitive scientist even if she never read about work in other fields, published in other fields, or contextualized her findings with the theories and problems in other fields.

- A cognitive scientist is any scholarly practitioner studying minds from one of the associated subfields who has a working knowledge of some of the other subfields and actively contextualizes her work with the theories and problems of some of the other subfields. She is active in the cognitive science community.
- Same as the definition above, except that she actively collaborates with scholars in other disciplines that use different methods. For example, an artificial intelligence researcher who works with a neuroscientist to make computer models of networks that execute some cognitive task. A cognitive scientist is any scholarly practitioner studying minds who uses methodologies from multiple associated subfields. For example, if a linguist runs experiments on human participants in addition to her traditional linguistic analysis. She also is a member of the community and contextualizes her findings.

## 2018-01-23 How cogsci can help you through school

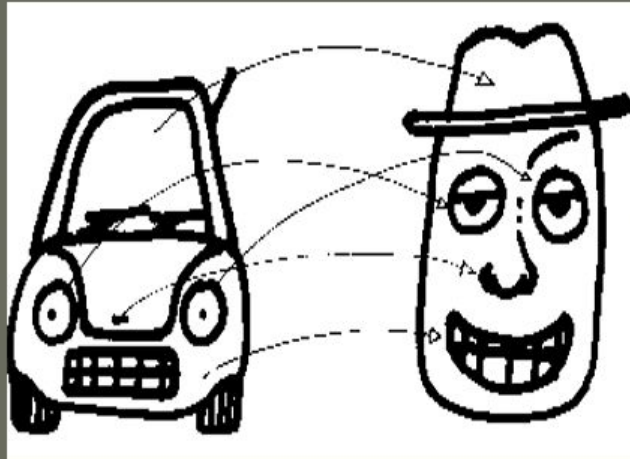
- Taking notes by hand remember more
  - People who type notes type too much
  - People who write by hand summarize leads to deeper processing
- Memorization
  - Guessing an answer even if you are wrong before you see the right answer facilitates memory more than not guessing
  - Testing helps memory a lot



- 
- Learning styles
  - There is little scientific evidence that people have different learning styles
  - Means some students are good/bad at learning or teacher. But its not the mode of presentation that makes the difference in grades

- Non productivity scenario 1
  - Elaine has important task to do
  - Does Not enjoy the task
  - Convinces herself to do other tasks like answering email
  - Day passes nothing is done, she is stressed out even more and ineffective
- Scenario 2
  - Aden works on only most important project he has
  - When he finally gets done he finds he has several projects on fire with imminent deadline
  - When he turns to the next most urgent one he realizes quickly that he needs something to get started from someone who is bad at responding in a timely manner
  - He is screwed
- Scenario 3
  - erika has project x to work on very tedious
  - Considers working on another project but figures if she will work she will do x
  - Ends up checking fb etc, gets nothing done feels like a failure
- Scenario 4
  - Ted has so much to do he cant face it, overwhelmed
  - He does nothing but distracts himself from the work
  - Rushes all his work out at the last minute
- Take a walk before studying remember more
- Overachiever: dumb but get high grades
- Underachiever: smart but get low grades

## Reasoning about corresponding parts of things



- Steps of analogy

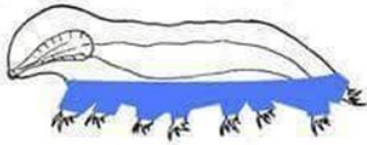
- Retrieval
  - Finding something good in memory to make an analogy with
- Mapping
  - Finding correspondences between elements of the two analogues
- Transfer/adaptation
  - Using (and changing) knowledge of one analogue to learn or invent something about the other
- Evaluation
  - Determining if the transfer did what you wanted it to do
- Storage
  - Indexing the memory so that it can be used successfully in the future



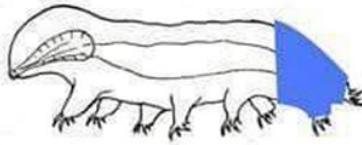
- Mapping between basketball and soccer
  - Basketball to soccer ball
  - Hoop to soccer net
- Basketball to kendo (sword fighting)
  - Hoop opponents body
  - Sword to basketball

If tardigrades wore pants, would they wear them

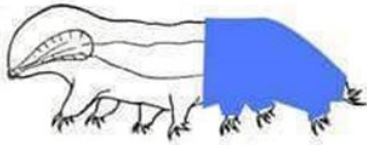
like this



or like this



or like this



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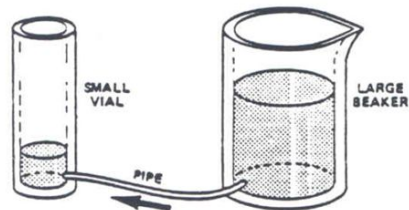
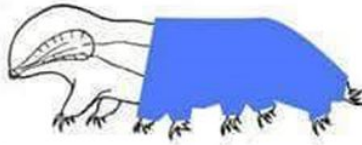
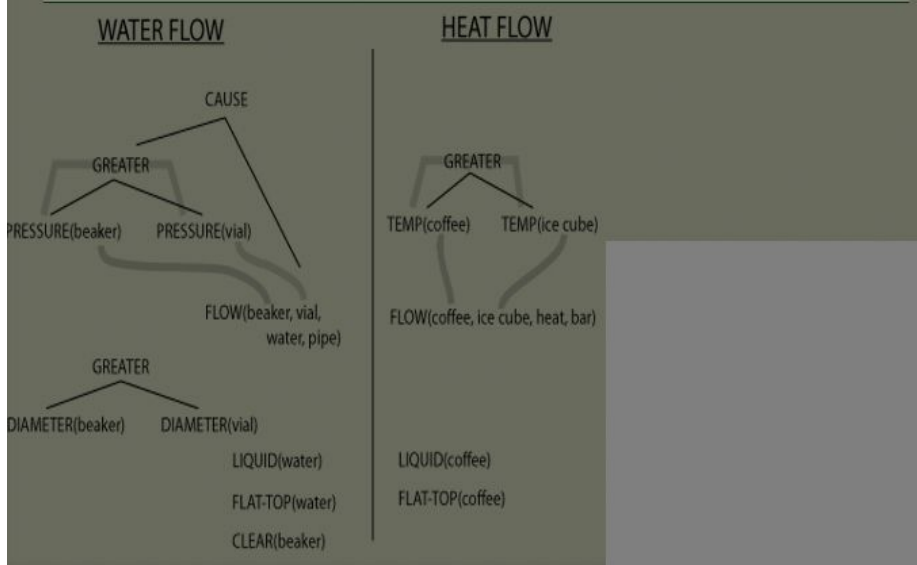


Fig. 1. Two physical situations involving flow (adapted from [3]).

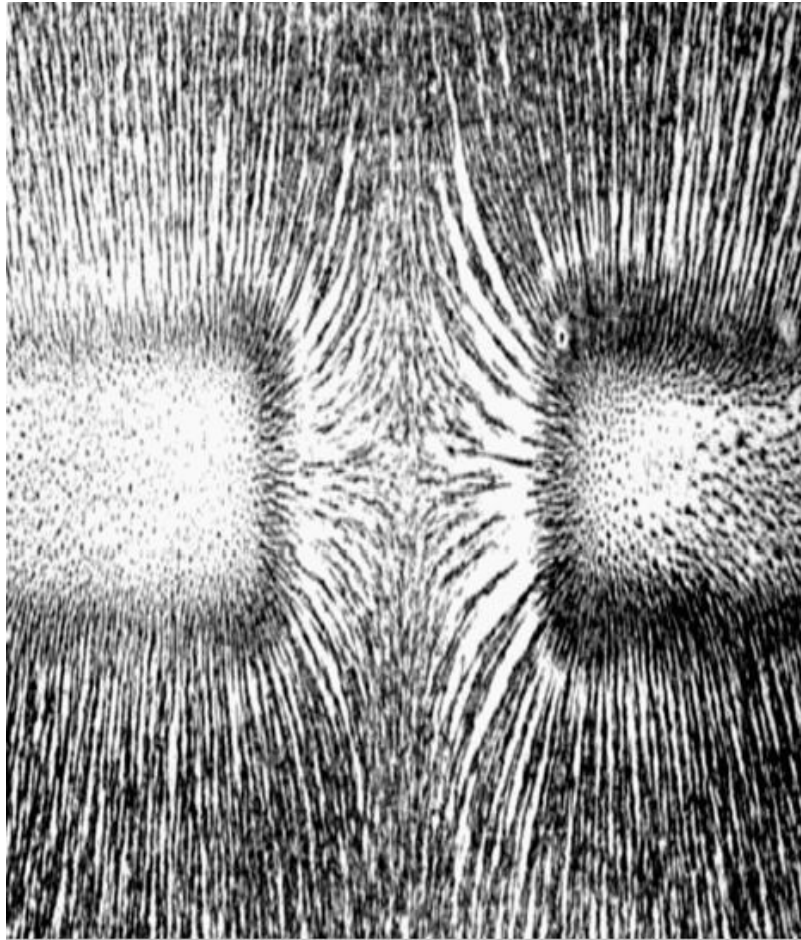
## Structure Mapping: Gentner and Forbus



- Transfer



- My friend wallace is like a bear (big hairy)
- Adaptation



## Adaptation

- Example from James Clerk Maxwell.
- Faraday's iron filings observation:

- 
- Evaluation
  - Upon evaluation one might go back and make different choices for retrieval, mapping, transfer or adaptation
- Storage
  - New information is stored in memory and indexed appropriately
  - How many words can you think of that start with k or r
  - How many can you think of that have k or r as the third letter
  - There are more words with k or r as the third letter but because of availability heuristic, which is at least partially a function of indexing



- - Where does perception end and analogy begin (face in the clouds, 2 chairs having sex)
- Analogies by other names
  - Exemplar based reasoning
    - Reasoning based on particular examples rather than on prototypes or rules (think of having a puppy you have met before)
  - Memory based reasoning
    - Reasoning from memories as opposed to using more abstract reasoning rules (reasoning based on specific past memories)
    - At an event everyone gets a free soda, you want another. One time before you got a dirty look for asking, other times you didn't
  - Instance-based reasoning
    - Same as exemplar
  - Case based reasoning
    - An AI field that reasons from cases in memory. (everything you experience is a case)
  - Analogical reasoning (mapping)
- Metaphor
  - Primary scene



- Cognitive representation of experiences everyone has such as swallowing
- Correlation-based metaphor
  - Base metaphor is sensory, target is abstract as in “prices have fallen sharply”, “up is good/down is bad”

## 2018-01-30 Language and Communication

- Language what is it
  - Structural description a set of symbols that can be arranged in certain ways
  - Functional description a complex code by which agents can communicate information
    - We say complex because we want to include animal communication
  - Natural Language created by cultures of humans
  - Artificial Language Created by individuals or small teams
  - Computer language artificial language for communication with computers typically lacking in ambiguity
- Animal communication
  - Also called zoosemiotics
  - Works through gesture, expression, gaze following, vocalization, olfactory (smell) communication, and electric colouration
  - Function dominance, courtship, ownership, food alert, alarm, metacommunication
- Human language
  - It has a structure but that structure is implicit
  - We all know how to do it, but we don't know how we do it so we have to study it like any other phenomenon. Our knowledge of how to speak is implicit not explicit
- Language is a brain interface
  - Like a computer programming language, natural languages allow interfacing between what might be two very different brains
  - Certain things are easy to describe: feelings, what a room looks like
  - Certain things are hard to describe: smells, faces
- Syntax parsing
  - $S \leftarrow NP + VP$
  - $NP \leftarrow (Det) + (Adj^*) + Noun$
  - $VP \leftarrow (Adv) + Verb + (NP)$

- John hit the ball
- (NP) (V) (Det) (N)
- Logic is a formal normative system of reasoning
  - Symbolic logic specifies ways that sentences can be represented unambiguously
  - for All x  
(if cat(x) then mammal(x))
  - But typical logic is very limited in its semantics
- Teaching animals human language
  - Chomsky says that getting non-human animals to try to talk is like trying to teach bees to build beaver dams
  - Linguists agree that animals do not have language - what they do is so primitive compared to what humans do that it is not even deserving of the word
- Animal require hundreds of trials
  - They have to use associative learning to associate a sound or picture with a concept. With humans they do it naturally
- Intra-brain communication the language of thought
  - Jerry fodor put forward the notation that our minds use mentalese or a language of thought
  - The fact that you have troubles sometimes expressing what you want to say support this view. How could you know what you wanted to say if the internal language were natural language?
  - Another reason might not be real. There is no language in dreams

## 2018-02-01 perception

- What is perception
  - The process by which agents interpret and organize sensation to produce a meaningful experience of the world
  - From a cognitive science perspective it means turning information from one form into new meaningful representation

- Typical sensory modalities

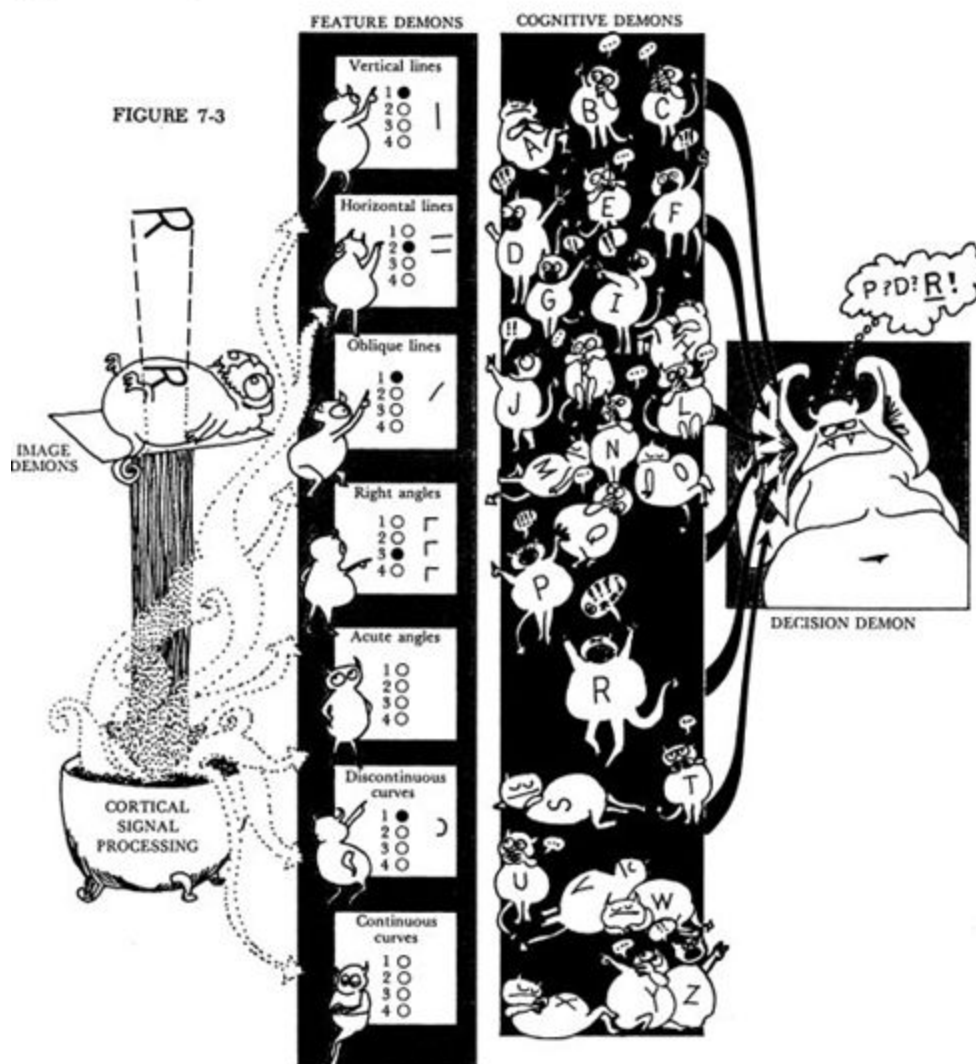
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Physical Signal	Perceptual modality
Light	Vision
Air vibrations (sound)	Audition (hearing), echolocation

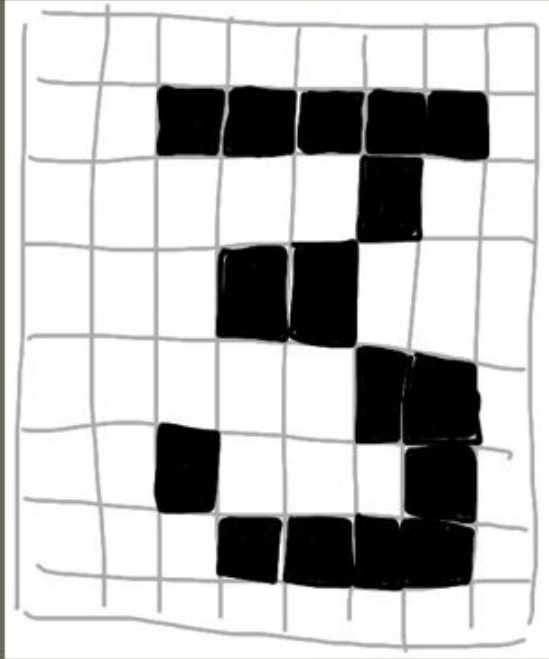
Physical pressure	Haptics (touch)
Chemicals	Taste and olfaction(smell)
Body position	Kinesthetics/proprioception

- Atypical senses in the bowel, stomach, pain receptors, heat receptors
- Human vision
  - Extramission theory
    - Rays of light emanating from the eye in combination with light in the world allow us to see (not believed anymore)
  - Intromission theory
    - Visual perception is accomplished by rays of light reflect from objects into the eyes
  - Human eye
    - Light is reflect into the eye and focused on the retina
    - Light stimulates the rod and cone receptors
    - Transduction of light into electricity
- Rods and cones on retina
  - The image is severely distorted and inverted
  - rod the most light sensitive photoreceptor cells in the retina (night vision)
    - 100 times more sensitive than cones
    - Information is received by a convergence or pooling from many rod cells resulting in a loss of visual acuity
    - Convergence of information makes peripheral vision sensitive to movement but can't actually see stuff well in corner of eye
  - Cone 3 types
    - Correspond to short (blue)
    - Medium (green)
    - Long (red)
    - Works best in bright light fewer cone cells exist for peripheral vision
- Depth perception
  - Size
    - We know how big things are
  - Perspective
    - Things are smaller on the fovea as they farther
  - Occlusion
    - When one thing is in front of another
  - Texture, shading and saturation
    - Closer things are more saturated, texture gradient

- Focus multiple images
  - Including motion and binocular vision
- Dorsal and ventral streams
  - Dorsal streams
    - “Where” pathway associated with motion, representation of object locations and control of the eyes and arms, especially when visual information is used to guide saccades or reaching
  - Ventral streams
    - “What” pathway associated with form recognition and object representation. It is also associated with storage of long term memory
- Pandemonium model of perception



- 
- Template matching perception



Looks for overlap of pixels

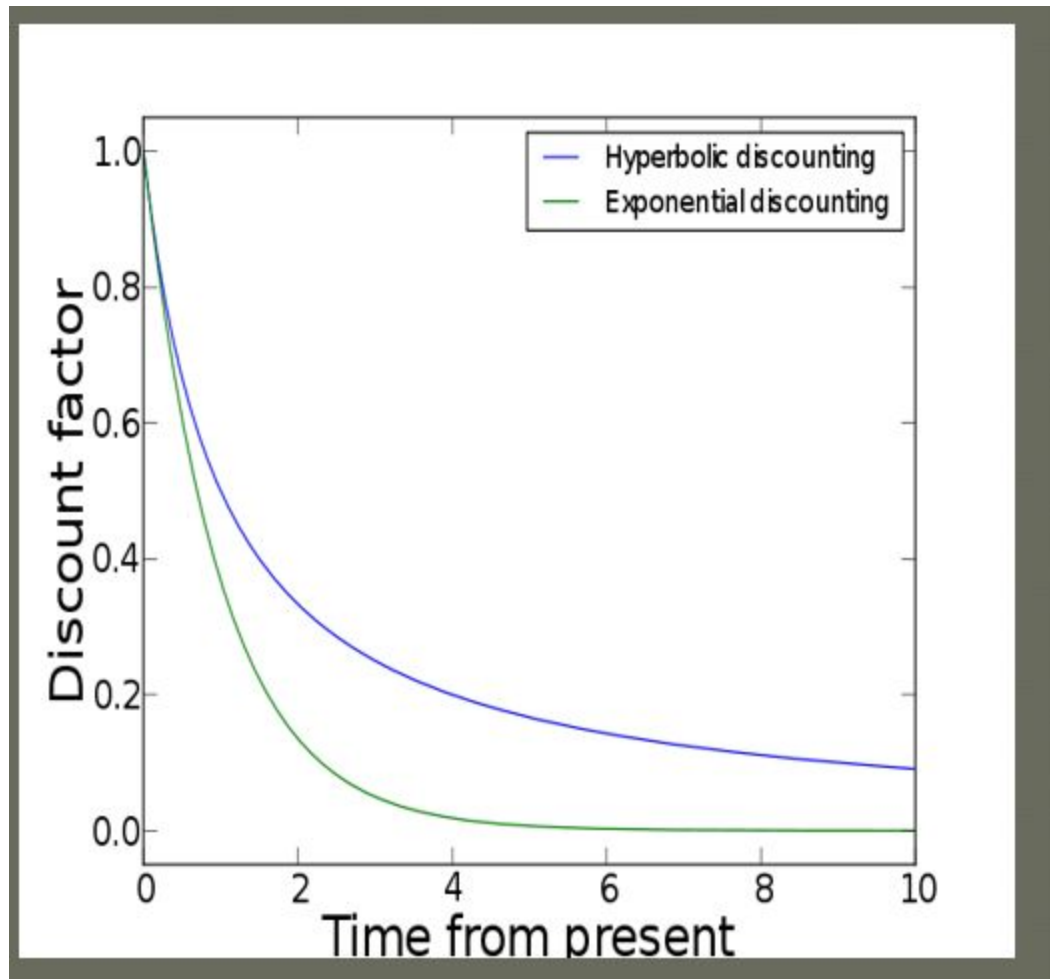
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- Neural network perception
- How audition works
  - Acoustical energy (sound waves) vibrate the eardrum (in air) or bones (underwater or through your own body as when you hear your voice)
  - Localization is done by examining the differences between the sounds in the two ears, somewhat like how depth is done with binocular vision
- Echolocation
  - Biosonar send out sound determine spatial information from echo
  - Bats, toothed whales, dolphins and two kinds of birds
- Haptics Touch
  - Critical for manipulation of objects in combination with proprioception (knowing where your body parts are even without looking at them)
  - Sensors are in the skin
  - Active perception
    - Haptics
    - Vision
- Olfaction (smell)
  - Detection of chemicals no clear energy continuum as there is for light and sound waves

- Some similar chemicals smell different, some different chemicals smell the same
- Much of what we experience as taste is actually smell
  - This is why food tends to taste bland when you have a stuffy nose
- Smelly t-shirt studies
  - Women detect immune system compatibility
  - Men detect ovulation
- Smell for animal communication
  - Territory, fertility, ant pheromone traces
- Gustation (Taste)
  - Chemical receptors in taste buds last for a week or two then wear out
  - The tongue detects flavors such as salty, sour, bitter, umami (savory) and sweet
  - Pain receptors react to spicy foods
  - The experience of food is very complex, involving feel, temperature, taste, smell and pain
- Kinesthesia, Proprioception and the vestibular system
  - Proprioception and kinesthesia are how you know where your body parts are and how they are moving
  - Sensors are in the inner ear and in muscles
  - Phantom limb
  - Motion sickness and vestibular system
- Interoception
  - Perception of hunger, need for digestive elimination, heart rate, the need to sneeze, breathe or cough etc

## 2018-02-06 Cognitive Biases

- Negative way to think about it how mind comes to an incorrect direction.
- Positive heuristic rule of thumb
- Anchoring
  - The anchor is what you compare to when you evaluate
    - Was starwars prequel movie good? Say it's worse than the original. Original is the anchor.
  - Restaurants will put a very expensive item on the menu, to make the others look reasonable. What is goodlife in Ottawa? In the Congo?
    - First world problems
    - Even if rich feel poor as compare yourself to even richer people
- Contrast Effect/Context Effect
  - If men look at lots of pictures of beautiful women, they will rate their wife as less attractive
  - If you are observing two things at the same time, you will focus more on their differences when evaluating
    - If looking at tv store, that tv looks brighter than the other one when at home won't be able to see
  - Distinction bias: things appear more different when view simultaneously
- Bandwagon effect and Herd instinct
  - You believe things because everyone around you believes the same thing.
    - Not using the same forks/knives during flu season, while holding the same door knob/bowls makes you more sick
  - This is why cults try to keep you from talking to people not in the cult
  - The herd instinct is believing what everyone else does to avoid social conflict
    - Not believing in evolution if your friends don't
  - Someone is vegan just because their boyfriend is
- Hostile media effect
  - When you watch the news, you tend to think they are hostile to your political views
    - If two opposite sides watch neutral view both think against their view
- Endowment Effect/Loss aversion
  - People will demand more to give up an object than they were willing to pay to get it
  - Once you own something, you will find it more valuable
  - My experience with proceedings and scanning

- Proceedings big book full of papers (scientific papers). Could pay 40\$ to get them scanned and into pdf. Prof didn't feel that he would pay 40\$ for the pdf
- Temporal Discounting
  - We value things in the future less than things now
  - 100\$ today or how much a year from now
  - Asking for favours
  - Chaotic environments discount more



- 
- Moral credential effect
  - Thinking of yourself as having acted morally can make you allow yourself to behave badly
  - People will compensate to reach an equilibrium in many contexts
  - Also called self-licensing or moral licensing
    - People wrote essays about condemning hate and then left the building. Less likely to give homeless man money vs other people
- Risk compensation



- Seatbelts
  - Drivers are a bit safer, but deaths passed on to others as driver feels safer and drives recklessly
- Bike Helmets
  - Cars drive on average 6 inches closer to you (debunked)
  - If your state gets bike helmet laws your chance of getting injury increased
- Dietary supplements make people eat more poorly and exercise less
  - Eat a huge salad before you eat the unhealthy junk food
  - Workout and then feel like you burnt a lot of calories and can eat a bigger meal than usual
- The safer you feel the more risks you will take and vs versa
- Confirmation bias
  - You accept, seek out and remember things that support your views
  - You also interpret things in a way that support your view
  - 2FE7 congruent bias
- Negativity Bias
  - People pay more attention to negative information
    - If you read flower, knife will remember knife better
  - Perhaps because its been more important in our evolutionary history
- Omission Bias
  - We think that doing harm is worse than not doing something that causes equal harm. Is this rational
    - Kick puppy and it drowns
    - Puppy in the pool and drowning and you dont pull it out
    - Should be the same badness, but people say morality wise kicking puppy in is worse
    - Don't give 5k to save someone's life
    - Kill someone
    - People think murder is bad even though in both cases kill people
  - Letting something back happens feels better than doing something bad
- Outcome Bias
  - Judging a decision based on what ended up happening rather than on the information available at decision making time
  - Is it right to punish a person who kills someone while driving drunk more severely than another drunk driver who gets lucky and does not kill anyone
- Planning fallacy
  - We underestimate how long it will take us to complete tasks in the future

- Makes it easy for us to overbook ourselves
- Unexpected things happen since we don't know what they are going to be we don't expect them to happen
- Wishful Thinking
  - Believing something because you want it to be true
  - Innocence of someone you care about
- Availability heuristic
  - Assuming that things that are most easily brought to memory are more common or probable
  - A problem is that vivid and emotional things are easier to bring to memory
  - So when the news shows you only murders, you tend to think that murders are more common than they are
    - 1980 a lot of news about drunk driving, people then thought drunk driving super popular, later news stops talking about it and people think less drunk driving
    - Likewise with driving on the bike
    - 1980 murders going down but cables show it more so people think murders going up
- Base rate neglect
  - If a test for a disease is 90% and someone gets a positive result, what is the probability they have that disease
- Belief Bias
  - If rain is wet then my roof is wet
  - My roof is wet
  - Therefore rain is wet
  - People already believe that rain is wet so any line of reasoning that gets this result is correct
- Conjunction Fallacy
  - What is more common, a person who wears birkenstocks or a hippie who wears birkenstocks
    - People who wear birkenstocks because every hippie who wears birkenstocks is a person too
    - But hippie fits into cultural group we think hippies wear them more
- Gambler's Fallacy
  - When flipping a coin over and over, which outcome is least probable
  - A HTTHTTTTHHHHTHHTTT
  - B HHHTTTTHHHTTTTHHHTTT
  - C HHHHHHHHHHHHHHHHHH
  - All equal chance

- Pareidolia clustering illusion, illusory correlation
  - Different ways for use to see patterns where none actually exist



- 
- Primary and recency effects
  - We remember the beginnings and endings better than the other parts of things
    - If vacation was great in the middle but at the end flight got delayed think the vacation was bad
  - Tested with colonoscopies
    - When tube is moving it hurts, when tube isn't moving its okay.
    - One group pulled tube out right away (people didn't like that)
    - One group pulled it almost out, waited a bit then pulled it out (people didn't mind this as much)
- Just world Phenomenon
  - If you think the world is ultimately a just place, you will have a tendency to look for reasons to blame victims of inexplicable injustices
- Actor Observer Bias
  - The tendency to explain the behavior of others in terms of stable traits
    - If someone cuts you off describe them as a jerk or worthless
  - And to explain one's own action in terms of reactions to the situation
    - If you cut someone off you say I was stressed, hungry, having a bad day
  - If good thing happened reversed
    - If you get good grades

- I am smart
- They get good grades
  - Just got lucky

## 2018-02-08 Cognitive Development

- Cognitive Aging
  - Fluid intelligence (IQ) goes up till age 25 then goes down
  - Crystallized intelligence grows till 25 then keeps growing slowly
- Language development
  - U shaped grammar curve
    - went , goed, went
      - Learn the word went all good, learn the rule you add ed to end of verb to make it past tense say goed shruggeded etc. then learn exception to learn
  - Universal grammar theory
    - The mind has a bunch of switches that get set when you learn a language as a child
    - Eg “subject omission switch”
      - In spanish you can omit the subject of a sentence but in English you cannot
        - Can't say speak english, you have to say I speak English
  - Every human being is born with a universal grammar language (noam chomsky)
    - Noam chomsky thinks this is true because you don't hear enough to learn all the switches yourself
- Critical stage 3-5
  - During this time children learn 2-4 new words per day to their productive vocabulary (words you can use not just understand), and twice that for understanding
  - That's 1 every one or two hours awake for years
  - They are learning words that they don't hear that day
    - Mother to father say do you want to go out for dinner response is sanguine. Next time response is good. You fill in the void sanguine = good
  - How is this possible?
    - Recall suddenly understanding a joke you heard years ago
  - If you learn a language after this age you will have an accent
- Jean Piaget's Developmental stages

- Sensorimotor (birth - 2)
- Preoperational (2 - 6)
- Concrete Operational (7 - 11)
- Formal Operational (11 - death)
- Sensorimotor stage
  - Simple reflex action to symbolic processing
  - Progress is seen on 3 fronts
    - Adapting to and exploring the environment
      - Focus on intentional behavior
      - Can't understand theoretical situation
        - Fake rule If feather can break a glass. And you hit the glass with a weather. Children still think it won't break
    - Understanding objects
      - Object permanence
      - Peekaboo hiding face they think it disappeared
    - Using symbols
      - For example, waving and gesturing
- Preoperational stage (2-6)
  - Use of symbols to represent objects and events
    - Characterized by
      - Egocentrism difficult in seeing world from another viewpoint
      - If baby with A,B. A hides marble in a cup, B leaves room, A hides marble somewhere else. Ask baby where B will look and baby says somewhere else not in the cup
    - Centration narrowly focused thought (only one part of a problem no conservation of liquid)
- Concrete operational stage
  - Mental operations to solve problems and reason eg: induction
  - Problems thinking abstractly and hypothetically
- Formal operational stage
  - Can apply mental operations to abstract entities
  - Abstract and hypothetical thinkings
- Piaget's lasting contributions
  - The study of cognitive development at all
  - Constructivism: that children are active participants in their own development
    - Children throwing toys on the ground see if you pick it up, see if crackers float in water
  - Counterintuitive discoveries, puzzles that other scientists needed to solve

- Problems with piagetian theory
  - Underestimates infants, overestimates adolescents
  - Vague on processes and change mechanisms
  - Does not account for variability (stages are not that clear cut)
  - Underestimates social and cultural influences
- Lev vygotsky
  - Focus on social and cultural
  - Intersubjectivity shared understanding among participants of an activity
  - Guided participation cognitive growth results from children's involvement in structured activities with others who are more skilled
    - Parents help you do stuff mentorship
  - Zone of proximal development the difference between what a child can do alone without with help
- Vygotsky
  - Scaffolding teaching style that matches the amount of assistance to the learners needs (like training wheels)
    - Like the alphabet song don't need to sing later in life
  - Private speech comments not directed to others but intended to help children regulate on their own
    - Practicing talking to themselves
  - Inner speech thought internalized private speech serving the same function
- Self-Control
  - The kids who could pass it were the ones good at distracting themselves
  - they turned out to be more successful in the future
  - Marshmallow test
    - Eat 1 marshmallow now or 2 later
  - Related to the discounting the future?
  - Criticisms of the test
    - Temporal discounting happens more if you live in a chaotic environment
    - Is it they have less willpower or just do the kids not believe in the promises because of their chaotic environment
- Information Processing Perspective
  - Children improve in the following ways
    - Better strategies (singing song while waiting for second marshmallow)
  - Increased working memory
  - Better inhibitory and executive functioning

- Can control emotions like anger
  - Increased automatic processing
  - Increased speed of processing
- Core knowledge theories
  - Physical objects we know that they don't move by themselves, if you throw it up will go down. Humans we expect them to move and heal.
  - Distinctive domains of knowledge some of which are acquired early
  - Explains why kids learn language but not calculus easily
    - Instincts go get friends, play to get physically active but not go to math because it's not an instinct
  - Against the general intelligence approach to development and cognition
  - Suggestions of what core fields are: language, objects, people, living things
  - Looking paradigm
    - Babies can tell the difference between animals but later the babies can't
    - Looking paradigm: Babies look at something they think is impossible longer
  - 4.5 months old have object permanence
    - Objects move in continuous paths
    - Objects can't move through other objects
- Core-knowledge theory living things
  - 12-5 months can tell the difference between animate and inanimate objects
  - Movement
  - Growth
    - But don't consider plants to be alive until 7 or 8 years of age
  - Internal parts
  - Inheritance
  - Illness
  - Healing
- People
  - Naive psychology
    - Like if eating a lot hungry
  - Theory of mind at 2-5 years of age
  - Still face
    - Parents don't react to child, child gets really mad

## Dreaming

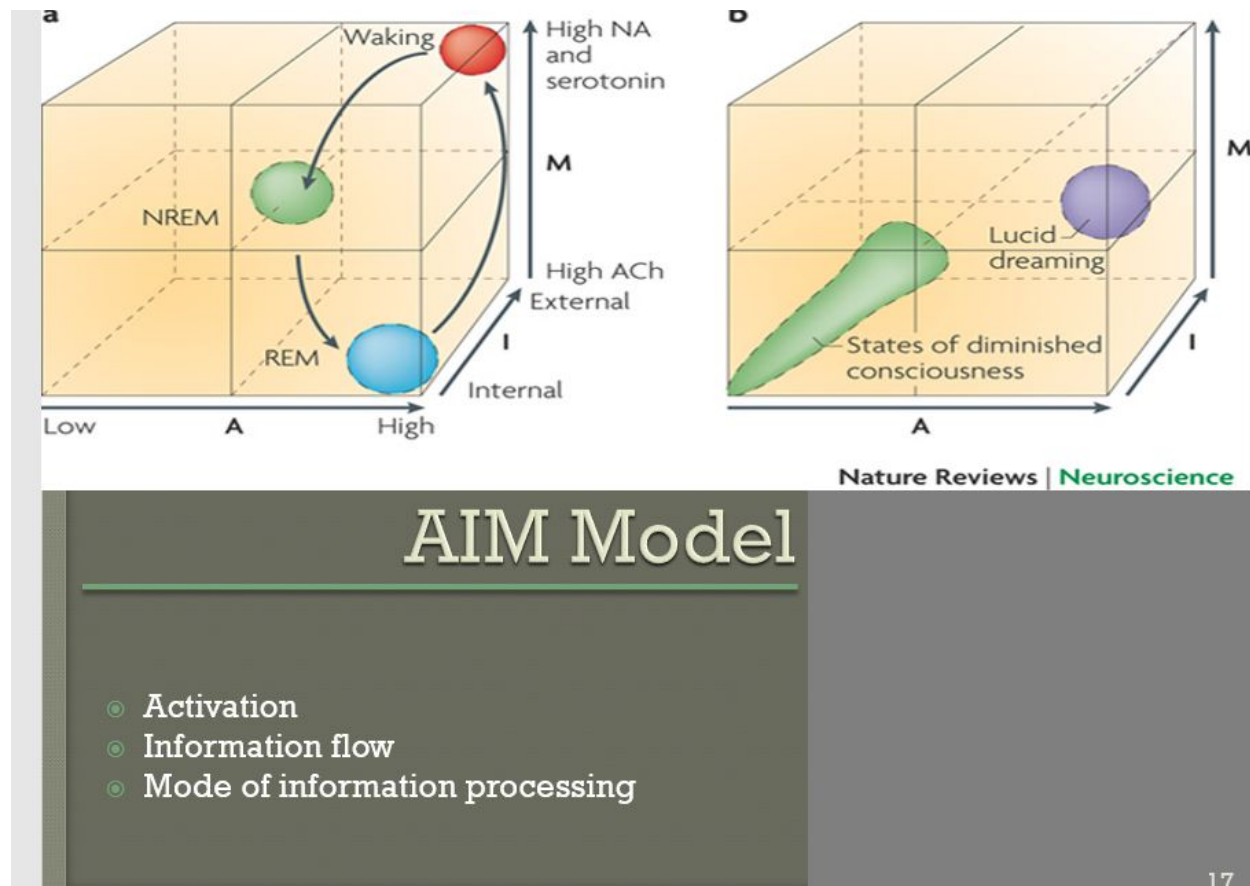
- Sleep and dreaming
  - Dreaming can occur in REM (rapid eye movement) and non REM (NREM) states
  - 75% of our sleep is NREM
  - NREM dreams tend to be short, dull and undreamlike
  - REM sleep is characterized by Rapid Eye Movement, muscle atonia, and often dreaming
    - Usually walk up during REM which is why you remember sleep, closest to awake
  - Cycles REM -> NREM -> REM
    - Usually don't remember dreams from past REMs or NREM
  - Muscle atonia body interrupts signals to move
    - Dream catching ball mind makes a plan to catch the ball (motor signal to catch the ball), muscle atonia stops that signal to going to your body and moving
    - Sleep walking might be part of having bad muscle atonia
- Dreams and waking states
  - People who have no dream imagery (visual anoneria) tend to also have a waking deficit in imaging memories (visual reminiscence)
  - Possibility that even if you don't remember dreams you dream subconsciously
- Dream recall
  - We typically forget dreams
    - One theory for that is you use dreams to practice, and you should forget the practice to not mix it up with real life
    - If you dream about beating up best friend, should not remember that in real life
  - Correlates with visuospatial skill and individual differences in working memory
  - Animals and infants cannot report dreams
    - Might seem like dog is dreaming, sleeping and moving feet and barking but we don't know
  - Commonly people assert that there was much more to their dream than they can report
- How to record dreams (worst to best)
  - Ask people what their dreams tend to be like
  - Ask people to keep a dream diary
  - Ask people every morning to report their dreams



- Wake people up during sleep at many points during the night and get reports (scientifically best way)
- What are dreams like
  - Scene shifts are common
    - Not sure why. Prof believes its due to TV because dreaming of black/white suggesting that dreams are due to media habits
  - Tend to be narrative
    - Series of events that follow a story
    - Someone is chasing you, you are hiding, you are fighting etc
  - Tend to be experienced “first person”
  - Dream emotion tends to match content
    - If you dream of something scary, you are scared
    - Dreams can be bizarre but not often in this way
      - Tend to remember weird dreams, talk about weird dreams and think that dreams are weird
- What else are dreams like
  - They are always animated
  - Dreams are rarely bizarre, but when they are we often do not really notice it until we are awake
    - Selection bias: bizarre dreams are easier to remember and are more often talked about
- What are dreams not like
  - films , visual images, recent social situations, and pre-sleep behaviour are rarely incorporated into dreams
  - Recent episodic memories, even salient ones are rarely incorporated
- Interference from the world
  - Dreaming you need to pee
  - Speculative dreaming of teeth falling out caused by tooth grinding (which 70% of people do during sleep)
- How can you affect your dreams
  - Pre-sleep attention to a specific concern (some type of problem)
  - This is called dream incubation
- Thread simulation theory (TST)
  - By philosopher antti revonsuo
  - A major function of dreaming is to practice dealing with threats that were common in our ancestral environment
- Support for TST
  - Animal dreams are highest in kids and decreases with age
    - Getting chased by wolves while never really seeing wolves

- Negative emotions (anxiety, scary) appear twice as often as positive ones
- The only kind of recurring dream with any frequency is being threatened by animals, monsters, people or natural disasters and the response was watching, running or hiding
- More support
  - Westerners dream of things we rarely experience
    - Spiders, snakes etc even thou no spiders or snakes here
  - Ancestral threats are overrepresented
    - Modern threats getting hit by a car, gun fire rarely shown
  - People react appropriately to dream threats 94% of the time
- Play and Phobia
  - Ancient survival behaviours are also over-represented in play and in phobias
    - Tag, hiding
  - Animals play appropriately for what they need to learn to do
- The dreaming brain
  - The brainstem is very active, sending information forward
  - The DLPFC (involved with executive function) is deactivated
  - Perhaps explaining our reduced reasoning ability during dreams
    - Savagely beating people, doing sexual things you normally wouldn't do
  - Not noticing what's weird
  - Uninhibited behaviour
  - But also our difficulty in remember dreams
- AIM model of conscious states
  - Bunch of random information is getting sent to the brain. Your mind turns this random information into dreams
  - Conscious levels depends on the activation, information flow and mode of information processing
- Activation
  - Basic level of brain activation
- Information flow
  - Sensory input vs internal fictive input
    - When awake Looking at the professor or thinking about a math problem
    - When asleep don't really know what's going on around us
- Mode of information processing
  - Aminergic cholinergic neuromodulation (neural transmitter)
- Activation-synthesis hypothesis

- Dreams are the cortex trying to make sense of chaotic inputs from the brainstem
- 



- Support for the activation-synthesis hypothesis
  - Dream emotion seems to shape dreams, not the other way around
    - An anxiety dream will often shift from one anxiety producing scene to another
  - Dream recall cessation is almost always caused by forebrain lesions (lesion = damage or removed)
- Lucid Dreaming
  - When you know you are dreaming and can control your actions and sometimes other dream content
  - You can only control your eyes in the real world
    - Proves that lucid dreaming. Can ask lucid dreamer to look specific places when he is in the dream
  - Could be a reactivation of the DLPFC, which allows you to see dream content for what it is and control yourself

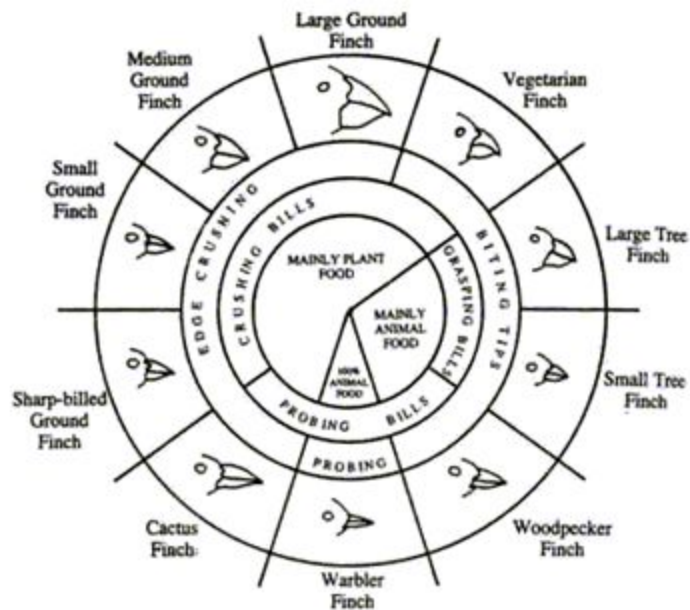
- Training: dream diaries, reality checks (during your waking time check to make sure you are awake)
  - Reality check: every time you see text read it look away and look back make sure its the same. In the dream probably won't be
  - Complex machinery usually doesn't work in dreams
- Used lucid dreaming to ask dream characters questions
  - Math questions? are you conscious?
- Sleep Paralysis
  - You feel awake
  - You might feel chest pressure
  - You can't move
  - It's a carryover of muscle atonia from sleep to waking
  - You have hallucinations, often of the presence of a malevolent character
  - You feel abject terror
- Robert Stickgold
  - Have people remember word usually in a specific field (nurse, syringe, band aid etc)
  - If you ask them if doctor was in the list they will say yes even if not in it
  - If you sleep in between getting the list and getting asked you said yes more often
  - False memories
  - Other task go through a video game maze, take a break then try again
  - Some awake during break some sleeping
  - People who slept did better
  - People who were awake thought about the maze whole time
  - People dreamt about random things bats in a cave
- Sleep good for clearing out garbage from your head

## 2018-02-15 Evolutionary Psychology

- Evolution
  - Occurs whenever these three things exist
  - Generation of diversity
    - Mutation, crossover
  - Selective reproduction and survival and reproduction of the fittest
  - Transmitted change
    - Genetic, taught and imitated
  - Evolution has no intent in it
- Biological evolution
  - Natural selection
    - Who gets to reproduce is based on the environment
    - Moth who has better camouflage will live longer and reproduce more so children will have better camouflage etc.
    - Can be luck as well Two islands bunnies on both, on one island bunnies all die to due volcano exploding only one type of bunny left
  - Sexual selection
    - Mate choice: organisms have choice of who to mate with. Rules based on which mate is picked is how evolution those organisms mate
    - Peacock gigantic tail takes a lot of energy and is long easier for predators to catch you. Mates like that can find food and can run away from predators. Only purpose is to attract females
  - Artificial selection (eg: breeding)
    - Human beings decide what animals breed like with dogs
    - Bananas
- Peppered Moth Evolution
  - Originally the “typica” moth (right) flourished in England, because it blended in with the lichens on trees. During the industrial revolution, the trees became covered with soot, resulting in the flourishing of the darker “carbonaria” (left). When England cleaned itself up “typica” made a comeback



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- The beak of the finch: a story of evolution in our time
  - By Jonathan Weiner (1995)
  - Finch beaks evolve with the weather



- 
- Evolutionary Psychology
  - Explaining psychological traits as evolutionary adaptations
    - What were the environments humans had to survive in and how did that affect our minds
  - Adaptationism: theorizing about evolutionary causes for phenotypes (trait)
    - Figure out what was in an environment caused that specific trait
    - Phenotype observable trait we can see/part of the body

- Genotype genes for why we have those traits
- Evolutionary psychology generates hypotheses, but these must be tested
- Many people will believe an evolutionary story with evidence
  - Theories sound really good and people believe them without needing any proof
- Different kinds of genetic influence
  - Predetermination
    - Mostly independent of environment (eg eye color)
    - Some traits even though they are due to genetic are triggered to produce due to some environment
  - Some traits are useless
    - Male nipples
      - Nipples form before sex is determined. They are useful for females but only constitute a minor nutritive cost for males
    - Vestigial organs (eg: appendix)
  - Exaptation
    - Something evolved for one purpose is used for another (eg female orgasm in primates (might have them because signal for a better partner), bird feathers, jaw bones exapted to inner ear bones in humans)
      - Almost everything in a human is exapted, eyes: probably started as some skin was slightly light sensitive to help them move this let them breed etc
      - Type of monkey can have an orgasm but it takes much longer than monkeys have sex for.
      - Ear bones used to be part of the jaw like lizards
  - Overridable
    - Eg bitter foods and drinks, such as coffee
      - Culture overrides what we as babies like, which is why some cultures like spicy, hot, sweet etc
  - Baldwin Effect (predisposition)
    - We evolved to learn something easily, eg: language
    - We have adapted to easily to be afraid of snakes
      - Mother screams at snake baby gets scared
      - Mother screams at lamp baby doesn't get scared
      - Two monkeys born in isolation. Monkey A show video of other monkey running from snake Monkey A scared of snakes. Monkey B show video of other monkey scared of Lamp. Monkey B Not scared of lamp

- Cortical and Neural Recycling
  - We like the taste of aspartame which has no nutritive value unlike sugar
  - Looking at photo of a beautiful woman. You like it because you want to be around beautiful woman but in reality you are just staring at a screen
- Cultural feedback loops
  - Less hair leads to fewer pests, making fire and clothing allows it to happen
  - We can sweat and out run animals and eventually eat them
  - Milk drinking: northern european countries had a lot of dairy products even though humans are bad at eating dairy. If you were were good at eating those products could survive better and reproduce
- Neoteny in humans (baby looks similar to human unlike baby gorilla and adult gorilla)
  - Small jaw
  - Upright posture
  - Big head
  - Less developmental change
  - Less aggression
  - Sexual and natural selection
    - More violent people get killed
    - 10% of people in hunter gatherer societies are killed through capital punishment
  - We domesticated ourselves
- The Silver Fox Experiment
  - Foxes got tamed and changed fur color and started to bark
- The mind from the perspective of evolutionary psychology
  - Our minds evolved mostly during the Pleistocene/Paleolithic time(the environment of evolutionary adaption or EEA)
  - Our minds are a collection of special purpose mechanisms for dealing with specific kinds of problems
    - It is modular rather than general purpose
  - These adaptations might no longer be beneficial
    - We evolved where fat and sugar were scarce no longer the case
- Morality
  - Recall the trolley problem
  - Whats the evolutionary explanation for this



- Mate selection
  - Evolution predicts that men will be most attracted to healthy woman who can bear children. Women should be most attracted to men who will provide resources to help raise the offspring
    - Birth is expensive (pain and nutrition and time when child in the womb), man less picky about mates while females are more picky because it's more of an investment
  - Men like a low waist to hip ratio (0.7) and low ratios produce smarter children and healthier women
- What women want
  - Smelly T-shirt experiment revisited
    - Women want compatible immune systems
    - Men prefer shirts of ovulating women
  - Testosterone makes men look more masculine (too much interferes with the immune system)
    - Women prefer masculine faces when ovulating
    - Women prefer more feminine faces when not ovulating
    - Women guess that more masculine faced men will be poorer parents
    - Testosterone correlates with divorce, infidelity and violence
- Memory
  - Prediction: we should remember better thing for survival (food, falling, etc)
  - In a word memory test this was found to be true
- Selfish genes and kin selection
  - Married people show modest correlations (.2)
    - Breadth of nose
    - Length of earlobe
    - Wrist measurements
    - Distance between eyes
    - Lung volumes
  - Length of middle finger correlates a whole 0.61
  - Similarity in general predicts marital success
- Wason cards revisited
  - Easier for some cases is you have a module for cheating/social rules

## Our Taste in Food

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- Fat, salt, protein and sugar are important nutrients that were rare in the vast majority of our evolutionary history.
- Now we live in a society that has abundant fat and sugar.
- We didn't evolve to deal with massive quantities of it— never had to.



## 2018-02-27 Morality

- Why do we have morality
  - They evolved to help us take care of the other people in our groups. But not so much people outside our groups
- The expanding circle
- Moral patient (things you care about)
  - Most rocks are not moral patients some people might think mount rushmore is a moral patient
  - Self-interest I care about myself and my family
    - All animals have instincts for gene-preservation (with exceptions)
    - Frogs taking care of their tadpoles
  - Friendship: I care for historical cooperation partners
    - Shared with chimps or bats
    - Sharing food used to be a life and death matter for us
    - Someone helps you, you might help them back
  - Tribalism: I care about us but not them
    - Not just family but nation, drama club, country etc
    - Tragedy of the commons
      - Several groups have access to resource. Every group has access to it and its over harvested
      - Great salt lake in utah. Fairly well protected in the sense that its entirely in utah. So if utah makes a law the lake will be under it
      - Mediterranean sea a lot of countries have a lot of access to it as a result overfished, polluted etc. Because countries don't make big laws against it since worried other countries will take still take the resources
    - Evolved morals in humans took care of this
    - Anthropological survey shows that ethnocentrism is universal
      - Ethnocentrism only care about your group not others
      - Groups are expanding over history used to burn cats during medieval history for fun. No longer do that. Same thing about what the animals we eat
  - I care about all people or creatures that can have positive or negative experiences
    - The tragedy of commonsense morality
    - Requires abstract reasoning and values
    - Cant really tell if a worm is in pain
- How do we know morality is evolved

- In general evolved and well learned behaviours work better than deliberate ones
  - Put people under pressure and more likely to be moral
- When you force people to play a prisoner's dilemma game quickly they are more likely cooperate
- Footbridge/trolley explanation
  - Greenes experiment reveals that there are two competing systems for our moral considerations
    - The first is some kind of rational, utilitarian calculus which makes switch cases permissible (utilitarianism)
    - The second is an emotional reaction caused by a dislike of getting our hands dirty
    - Utilitarianism vs deontology
    - You and others are hiding from enemy soldiers. You have a baby that will cough. Do you kill it and let everyone survive? (utilitarianism) or do you not kill it and have everyone die (deontology)
- Haidts moral foundations theory
  - care/harm
  - liberty/oppression
  - authority/subversion
    - Subversion breaking the rules
  - fairness/cheating
  - loyalty/betrayal
    - Loyalty: really shouldn't hurt your friends/families
    - When a friend of yours commits a crime do you hand them in
  - sanctity/degradation
    - Sanctity some things are sacred
    - In US should you be able to burn the flag or not
  - Mnemonic CLAFLS
  - Moral outlook based on switches which each of these 6 are set to
  - People who are left/right winged care about different things
    - Right wing (conservative) care about all of them
      - Tend to care less about environmental protection
    - Left wing only care about 3 care/harm, liberty/oppression, fairness/cheating
    - Left wing say prostitution if no one gets hurt what's the problem
    - Right wing have problems with sanctity even if she likes to she shouldn't do it to the body. Violation to sell yourself for sex
- Disgust

- Emotions can trigger moral judgements
- People who disgust us (hippies, the obese people we view as “trashy”) we judge more harshly for purity-related moral infractions
- Such as keeping your cubicle clean
- Versus not tipping a server
- Police are more likely to arrest obese people for purity related crimes such as drugs, prostitution and lewdness
- Moral dumbfounding
  - A man brings a home a ready to cook chicken, brings it home has sexual intercourse with it then cooks and eats it
  - Did he do something morally wrong?
  - Most people say yes but can't really explain why
  - No good reason can be given
  - Adds more evidence that moral judgement is based on emotions
- Should you trust your instincts?
  - Hard to tell what is instinct vs what is really well learned
  - People look to their feelings to judge whether something is moral or not
  - You can make people think is more immoral with bad smells or bitter drinks
  - Feelings vs principles
  - If moral situation might have been something have been your ancestors have been in trust instincts
    - If pulling a switch to kill someone feel no remorse. But ancestors didn't have switches to kill people. Take a step back and use reasoning not feeling
- Politics and morals
  - Right wing people tend to have all six moral foundations fairly strong
  - Left wing people tend to have only care/harm and liberty/oppression strong
  - Libertarians tend to only have liberty/oppression strong
  - This is mostly genetic which means your politics is mostly genetic
- Pillars of morality
  - Reciprocity (fairness ) and empathy compassion
- Animal morality
  - Prosociality
  - Empathy and condolence
  - fairness , reciprocity friendship in chimps
    - Chimps will kiss and embrace after a fight

## 2018-03-01 Religion

- 4000 religions current religions
- Thousands and thousands of religions that have died
- Pascals boyers counterrontology theory
  - We have subsystems for understanding different things in the world: contagion, persons, living things, tools, physical objects These form “ontologies”
  - We find fascinating things that belong to one category but have one or close to one from another category
    - A ghost or a god is a person without a body
    - A zombie is a person with no mind
    - A crying statue is an object with one biological property
  - Studies show that people these one violation concepts the most plausible (Barreet)
  - Gods tend to be things from one category with one/two things from another category
  - What is a reasonable god?
    - Statue making soup but baby making soup not a god because baby making a soup isn't breaking out of the category
- Person permanence
  - Our belief that people still exist when we can no longer perceive them
    - Useful because people usually dont disappear
  - It seems that this does not shut off immediately when someone dies, leading to beliefs that their minds still exist
    - If someone dies that is close to you, sometimes you feel like that person might just walk through a door
    - After someone dies lasts about 3 months
  - Studies show that most people even self-described atheists, attribute mental states to the dead
  - We seperate the body and the mind
- Is this learned or innate
  - If something is learned we predict that it gets stronger during enculturation
    - Enculturation learning things by watching those around you table manners, guys stand with legs apart girls legs together
  - The opposite happens with attributing mental states to the dead. Kindergarteners were more likely to do this than older children
    - Kids say sun is shining because he is happy
  - This suggests that there is a n innate component. Are we natural dualists
- The old brain and the new

- The old brain is intuitive. We are conscious of its outputs not its processing
- People's implicit reasoning about the supernatural can be at odds with what they say they believe
  - Can say you believe that God knows everything but subconsciously think God has human characteristics and can't really know everything
- Most popular religions have scriptures and complex hierarchy of religious authorities
  - Most religions don't have scriptures and don't have complex hierarchy
- Religious authorities can't stretch the religion too much or else people won't buy it
  - Most people don't believe in all of the religion just parts of it
  - If church says something people don't like they go to a different church
- Dead bodies are naturally counter ontological
  - We are fascinated with corpses because they bring up intuitions from different systems that are contradictory. Religion comes in to fill the gaps
    - Our contagion system makes us fear it
      - We are scared of rotting dead animals not really plants
      - We are more scared of animals that are close to us ie more scared of a rat than a lizard. And likewise more scared of a human vs rat
    - Our theory of mind (person permanence) makes us think the person is still around and we might feel love
    - Our biological system tells us it is dead and can't move
  - As a result all religions have prescriptions with what to do with corpses
    - Often religion tells you to do what's healthy with the corpse
    - Tibet cold, mountains, windy. If someone dies put it in the home for 3 months, put yak butter in the hair. Can only do this because it's cold in the mountain
    - Jungle can't do that because body will rot. Cultures there bodies will be buried or burned
  - Whereas things like gods or magical objects have to be in some sense invented (either by persons or by cultures) corpses are universally compelling
- Explaining dual funerals



- According to anthropologist pascal boyer these are common. The body is buried and then some time later it is disinterred and something else is done
- Boyer says this is to make sense of our changing intuitions about the status of the dead person
- The first ritual is to remove the body even though we believe the person still exists
- And the second is to mark the change of our acceptance of the person being gone and only existing in our memories usually after 3 months due to person permanence
- If religion came out where you reburied after 1 months it wouldn't stick as well because people wouldn't believe it
- Theories religion encourages prosocial behavior
  - Imagine how a monkey reputation could be hurt in a pack. Without language your reputation can only be hurt in minds of those directly who see you
  - With language a reputation can spread and affect someone for years
  - One theory says that humans evolved to have beliefs in supernatural agents(such as gods) to keep us behaving even when nobody's watching
  - This requires group selection which is very controversial
  - Fear of being gossiped about stops you from doing bad things when people are around
  - If tribe is atheist and food is scarce
    - People when left alone with the food will take some food since no one is looking, tribe will die and not reproduce
    - If tribe is religious might not take the food since god is watching will survive and reproduce
  - Most religions make group the other people in the religion
- Evidence
  - People are more prosocial when primed with (shown, reminded of) supernatural concepts
    - If you show a person a bunch of words god, angels and then ask them to do a task they will usually pick the good option vs selfish
  - People think gods have strategic knowledge. Gossip is theorized to have a similar function and it also focused on strategic knowledge
    - People think God will care about you stealing money from your mum when you were 10 but not how what color clothes you are wearing
- Origins of religious belief and ritual and mental illness

- In traditional societies, schizotypals and epileptics are often perceived to be blessed and set the societies religious tone
  - Mania
  - Obsessive-compulsive order
  - Schizophrenia and schizotypal personality disorder
  - Temporal lobe epilepsy
  - All of the above correlate with religiosity
    - Religiosity (how religious are you)
- Obsessive compulsive disorder
  - Characterized by compulsive rituals: checking, cleaning, entering and leaving spaces, hoarding, numbers affects about 2% of people
  - Hyperreligiosity is a major feature of OCD
  - Orthodox religions are replete with food and body cleansing, repetition of mantras, numerology and portal rituals
  - Failing to engage in the ritual causes a feeling of dread
  - Participants of religious ritual and OCD patients alike do not know the mechanism that connects the ritual to future events
    - Don't know how not doing the ritual will be bad but they have a feeling of dread and something bad will happen in the future
  - People with OCD are attracted to religions, particularly ritualistic ones such as Catholicism
- Schizophrenia and schizotypy
  - Schizotypal Affects 3% of people
    - Schizotypal is lighter schizophrenia
  - Features hallucinations (voices in your head or visions)
  - People who experience delusions tend to have more religious beliefs
    - Delusions think people are watching you or that the fbi is watching you
    - Will see meaning in nothing why are all those people in the line
    - Say sun is shining through the leaves in a different way today is a special day
  - Because schizotypals are likely to be treated as having been blessed, their hallucinations can become accepted as divine truth
  - Amped up pattern detection
    - Seems to be linked with having more dopamine
- Dopamine and pattern detection
  - Experiment in which skeptics are given L-dopa
  - Blur a bunch of faces

- People with high dopamine have better ability to see which images have faces
- Religious people tend to have more dopamine
  - More able to see blurred faces but also more likely to see faces that aren't actually there
- Why are individuals religious
  - As with most things psychological religiosity is about 50% genetic and 50% environmental
  - Specifically
    - Genetics 47%
    - Environment
      - Family upbringing 11%
      - Non-family environment 42%
- We create or call upon religious ideas when we encounter something out of the ordinary
  - Unfortunately human beings constantly see patterns in truly random processes
  - The termite collapse
    - Collapse of a building, people think the people inside must have pissed off a witch caused the house to collapse. Researcher says there are a ton of termites and asks don't you think it was because of that? People say but why did it collapse on them
  - Fishing people and the lagoon
    - Thinks it was because he did something back to his uncle
  - Karma

## 2018-03-06 Imagination

- What is imagination
  - Creativity in general
    - This lecture is not about creativity
  - Sensory like experience based on internal rather than external information
    - To distinguish it from perception
    - Imagining yourself holding up to fingers (not creative but is imagination)
- Frequency
  - On average people think about the future once every 16 minutes (a lot about the future)
- We use memory to make imaginations
  - People who have trouble remembering (eg elderly, alzheimer's patients) also have trouble imagining the future
  - Many of the same brain areas are active for both tasks (the default network)
- Imagining the future
  - Future imaginings have less detail and are more prototypical
    - Prototypical (stereotypical/average) if imagining a birthday party will think about a cake and regular party
    - Ask about party in 2 weeks will think more about prototypical
    - If think about party 2 weeks ago might be less prototypical
  - Impact bias: we think that future emotional reactions will be stronger than they really will be. This is true even for imagined past events
  - Imagine the steps to achieve a goal no the achievement of it
    - If you imagine a goal less likely to do it because you already felt like you did it
- Kinds of sensory imagination
  - Visual
  - Auditory (song stuck in head)
  - olfactory/gustatory
  - Haptic (what it feels like to jump into a cold river)
  - Emotional
  - enteric/sexual/hunger etc
  - Motor/kinesthetic
- Imagination vs mental imagery
  - Aphantasia have no conscious experience of sensory imagination but is it right to say they have no imagination at all?

- Can you imagine a polygon with 3 sides? (yes) How about 1280 (either picturing with way few than 1280 or you are picturing a circle)
- Dreaming about somebody who looks like someone else but you “know” is your mother
- Mental imagery is the final optional stage of imagination
  - “Imagine a living room” instructions
  - Pull from memory things that belong in a living room: sofa, chair, coffee table, ceiling, window, TV
    - (coffee table in front of sofa)
    - (book on coffee table)
    - (TV attached to wall)
  - Aphantasia stop here
  - Mental image
- Evidence that long term memories are not pictures
  - Degraded memories are not blurred or pixelated
  - “Attack formation” on a chess board is not a visual property
  - We can retrieve based on word queries
  - Missing objects are not blank spaces
- How hallucinations differ from imagination
  - Example of hallucination: pressing on eyeball seeing color
  - Often involuntary (thought sometimes imagination is also involuntary as in post-traumatic stress disorder or if someone says “jim your parents had sex on the beach” involuntary think about it and get grossed out)
  - Often believed (thought not always)
    - If on drugs talk to a spider, when done your high you realize that was dumb
    - Not always though for example migraine, see things at the corner of your eye weird ripples but you don't believe that it's real
    - Imagination can be believed to, study asked people to imagine the song “white christmas” people then thought it was actually played in the room beside
  - Often “projected” on the real world (thought imagination can do this too, as with imaginary companions, and sometimes hallucinations track the yes)
    - Example schizophrenia Imagine a person coming at you with a knife, even if you look away and then look back will be still there
    - Other mental illness when you go into epileptic shock have hallucination where you go to the another world and remember it
- Schizophrenia and hallucination
  - Almost all (hospitalized) schizophrenics hear hallucinatory voice

- So do about a third of non-schizophrenics, but with schizophrenia they are often threatening, jeering or persecuting
      - In some cultures the voices are nice, might be due to some religions think hallucinations are divine and from the gods, gods are nice so voices might be nice
  - Delusions and hallucinations
    - Delusion: a belief about the world/interpretation is off see patterns in nothing and get worried
  - Difficult to disbelieve
- Hallucinogenic drugs
  - LSD, Hashish, mescaline, artane, psilocybin mushrooms
  - Multi-sensory and meaning rich, often pleasant
    - Can have bad experiences too
  - Sometimes believed if enough of the drugs is taken
- Epilepsy
  - Depending on where in the brain the seizures happen, different hallucinatory effects will result
    - Seizure is a result of part of a brain has chemical/electrical mess up
  - In higher brain levels (parietal and temporal lobes) one might have cartoony figures
  - At even higher levels one might hallucinate a complete hallucinatory world (temporal lobe epilepsy for example)
  - At lower levels you just get simple things like spinning lights or lines
- Charles bonnet syndrome
  - Only visual
  - Most people hallucinate shapes, color or patterns, but never people or objects
  - More complex: imagine faces notation (music or text) on the floor or on the wall
  - More complex: imagine costumed people marching around
    - Never interactive, never familiar, never emotional, never meaningful
  - Problem in V1 and V2, low level visual brain areas
  - Usually not believed
  - Do not lead to delusions
  - We can get CBS symptoms from sensory deprivation either from meditation or sensory deprivation tanks

Brain area	Level	Hallucinations
Occipital cortex	Early	Shapes, orientation, patterns
<u>Inferotemporal cortex</u>	Later	Animals, objects, letters, faces

○

Imagination has more activation in the frontal areas associated with executive control.

Hallucinations originate elsewhere.

The part of the visual system that is impaired predicts what kinds of hallucinations you will have

- The ways hallucinations differ
  - Voluntary-involuntary
  - Come full formed or are assembled bit by bit
  - Meaningful or meaningless
  - Believe or not believed
  - Sensory, delusory or both
  - Simple or complex
  - Vividness
  - Detail
  - Projected onto external space or just into visual field
  - Reacts to hallucinator or doesn't (participant vs spectator)
- Daydreaming
  - Thinking about things unrelated to your current task
  - People mind wander about 47% of the time
    - Love making seems to be the only activity that people don't daydream during
    - People are happier when thinking about what they are doing even if the task isn't fun
  - Pilots daydream they have nothing else to do (computers mostly fly the plan)
- Maladaptive daydreaming
  - Intense compulsive daydreaming that interferes with one's life

- People get grumpy if they cant daydream
- Might go on for many hours
- Counterfactuals
  - In general thinking about how your life could be worse (downward counterfactuals) make you feel better and vice versa
    - I could be half as smart
  - But not always downward counterfactuals that make you think “that could have been me” makes you anxious and scared
    - What if more people liked me, what if i was smarter etc
  - It depends on whether you feel a part of the imagined situation (relate to the person inside the counterfactual) or contrast your life with it
- Imagination as mental training
  - People who imagined putting the ball in the hole puttred 30.4% better
  - Imaging doing sports makes you better at sports
  - Finger strength could be increased by 22%, which is almost as much as doing isometric exercise which increased strength by only 30%
  - 20 minutes is the optimal amount of time for mental practice
    - Less and it doesn't stick
    - More and you lose too much touch with feedback from reality
- Imagination and fighting bias
  - Imagining fighting the bystander effect helped people fight the bystander effect
  - Imagining people doing something counter their stereotype reduces prejudice
- Imagination and diets
  - Imagining eating a food habituates you to it and you end up actually eating less of it
- Imaginary companions
  - What one is
    - Hard to differentiate from toys imbued with “life”
  - It is common
    - 65% of children under 7
    - 28% of 16 year olds
  - Harmless
    - Thought they might be caused by other problems, they are not the problem
    - Often it's helping not hurting
      - Helps with being lonely not enough companionship
- Why do kids have them?



- There isn't always a clear reason
- Being alone or neglected
- Are kids confused
  - Kids don't actually believe in them
  - They are not always friendly some are scary
  - They are not always under conscious control of the child (kind of like a dream character)
    - Crying because friend was busy
      - Family goes to the zoo but friend can't go because busy. Kid gets sad and cries
    - 34% of kids sometimes get mad
  - Writers and their characters
    - Twice as likely to have had imaginary companions as kids
- Uses of imaginary companions
  - Feeling competent in contrast or inspiring
  - Form of play which helps regulate emotions
  - Expressing emotion
  - Scapegoating
    - Say don't wanna go somewhere because friend is scared of it but in reality he is scared of it
  - Getting out of chores
  - Company

## **2018-03-08 consciousness**

- Meaning
  - Awake
    - Not asleep
  - Conscious of something
    - Awareness of an oncoming car
    - We are aware of much less than we think
  - Conscious of self
    - Descartes "i think therefore i am"
      - Worried about if we can trust our sense ie we are looking at tree but its really a reflection, lines breaking when they enter water
      - Can fool sense but you know that someone exists because something needs to experience the senses even if they are being fooled
    - Awareness of what is doing the action or having the experience

- We will be discussing consciousness of the latter two types. It is possible to be conscious in the latter sense whilst not being awake (ie dreaming)
- Automatization
  - As we get better at things they become easier to do and faster and we can think about other things while we do them
  - Driving is a good example or tying your shoes
  - We become less conscious of the activity
  - It gets so fast that making yourself conscious of it will mess up performance
    - If you are running up stairs and decide to go two stairs then one stair at a time you have to slow down to do that
  - Perhaps babies are more conscious than we are because they are habituated to nothing and need to focus on everything
- Consciousness is not the main event
  - Much of what the brain/mind does is not available to consciousness or does not require consciousness
  - It is like an iceberg only a small part of the mind is available to reflect on or control
    - Can imagine a rich person: wakes up and finds clothes to put on, goes downstairs sees a packed bag and breakfast. Person forgets about all the things that needed to happen
  - AI has the potential to do all kinds of stuff without consciousness
  - We just don't know enough about it to know
  - Another possibility the rest of the brain is conscious but not available to us we see that this is possible in the case of split-brain patients
- Intuition
  - When we perceive or decide or believe something without having an option of how the idea came about
    - Should I eat A or B, should I trust this person
    - Someone tells you something and you say it's wrong, they ask why and you don't know why until you start explaining
  - Can be caused by automatization
    - The better you are the more automatization it is eventually you don't even know how you do it
  - We have genetic and learned intuitions
  - We cannot tell the difference
  - When can we trust it
  - Old brain processes are mostly impenetrable

- For example cant figure out how the eye sees a border between two objects
- Qualia
  - The qualities of consciousness what it is like to see, hear, taste etc
  - An example of a quale (plural qualia) what the colour red looks like or what pain feels like
  - There is a debate in philosophy regarding whether qualia are reducible to physical processes and states
- Weird consciousness disorders
  - Blindsight (ability to guess above chance aspects of visual stimuli in absence of perception)
    - Are blind but have a better than average chance of what's in front of them
    - Might be because eye sends messages to multiple parts of the brain. If one is cut messages still sent to others. So you cant see it but other parts of the brain might react to it. Cant read books but might react to looming things
  - Hemisphere neglect (damage to the brain causing deficit of awareness of one side of space)
    - Left hand controlled by right half of the brain, right hand controlled by left half of the brain.
    - Left hemisphere controls left visual field for both eyes vice versa for right hemisphere
    - If one hemisphere gets destroyed might lose one of their visual fields
  - Severed corpus collosum (split-brain or commissurotomy)
    - Right hand reaches for a dress, left hand slaps the other hand as both sides of the brain have different ideas of what to wear
    - Hemispheres can't communicate



- In philosophy a zombie is a being that is like a human but has no conscious experience
- Behavioural zombie: behaves just like a human
  - Eg chinese room
- Neurological zombie
  - A behavioural zombie, the brain states of which are indistinguishable from a human
- If zombies are possible then perhaps some form of dualism is correct
- Dualism is the belief that there is some kind of mental substance that is not physical
- Baars global workspace model
  - Consciousness highlights certain parts of memory that are viewable by other processes
  - Similar to a blackboard architecture in AI
    - Write let's go home on the blackboard
    - All the people in the class are brain processes
    - Each individually and independently process this and try to do something
- Dennetts Multiple drafts model
  - There are multiple processes in the mind that interpret things. These are like multiple drafts of the same story such as picking up a glass of water
    - If deciding what to eat: process to check if you can afford it, process to check what you like, process to decide what's environmentally better etc
  - They compete for control over other parts of your mind
  - There is no set point at which something becomes conscious

## **2018-03-13 Cognitive Architectures**

- What is a model
  - Across fields its a representation of something that excludes unimportant detail and information
    - A scale model of a home made of cardboard
    - A categorization scheme for the students in my class
    - A simulation of a hurricane
- What is a cognitive model
  - Typically its a computer program that models some aspect of thought
    - Sometimes pen and paper of how memory moves from short term to long term memory

- For example it might model how people do categorization or how a mouse learns to navigate a maze
- Model makes predictions that can then be compared to data
- If the predictions match the data it supports the theory underlying the model
- What is a cognitive architecture
  - A programming environment or set of tools for making cognitive models
    - Architecture like a model but more abstract has basic stuff for how brain works
    - CAD (Computer assisted design) is an example of architecture
  - Typically it includes constraints on how cognition works in all people, speed of learning, memory retrieval (ignoring cultural and other learned aspects)
  - In some ways it is easier to make a model in architecture and harder in other ways
    - In cognitive science if your model fits the popular architecture makes it seem better because everyone trusts the architecture
    - Harder if your model doesn't fit the current architecture
- Kinds of cognitive architectures
  - Symbolic
    - Operates at the level of discrete symbols
      - Numbers etc
  - Sub-symbolic
    - Operates using number representations which in aggregate constitute symbols
      - Might represent the number 6 visually using a grid filling in the bits 1,0s
  - Hybrid symbolic/subsymbolic
  - Brain
    - Models cognition at the level of biology but speak to cognitive issues
- Symbolic architectures
  - Production systems
  - For example (assuming words beginning with capital letters are variables and other words are constants)

```
If      [Person, age, Number] &
        [Person, employment, none] &
        [Number, greater than, 18] &
        [Number, less than, 65]

then    [Person, can claim,
        unemployment benefit].
```

- 
- Typical characteristics of symbolic architectures
  - declarative/procedural memory distinction
    - Justifications: HM and other brain damaged patients
      - HM had a lot of seizures, destroyed part of his brain.  
Couldn't create long term memories, remember old ones but not new ones. Couldn't remember that he had this operation
      - Seemed to be able to create long term procedural memories
    - Our inability to to consciously retrieve and reflect on procedural memories
  - Goals are subset of declarative memory
    - Declarative memory is part of memory where you store facts
  - Production compilation models automatization
- Subsymbolic: associative network
  - Uses hebbian learning to learn patterns
  - When it gets incomplete input, it can complete it based on the weights
  - Between the nodes it is unsupervised learning

## 2018-03-22 Cognitive Science in Film

- Memento
  - HM is the most famous case. Anterograde amnesia
  - Able to learn procedural but not declarative memories
  - People who get their hippocampus lesioned now are warned can prepare
- Inside out
  - Core memories
  - Basic emotions
    - fear
    - Anger
    - Joy
    - Sadness

- Surprise
  - Disgust
- Person vs self
  - No antagonists
- No account of reason
- Solipsism, reality, virtual reality
  - Matrix, dark city, the truman show
  - Solipsism
    - Idea that nothing exists but you, everything you experience is a dream/imagination
  - eXistenZ
    - Virtual reality video game
  - The thirteenth floor
    - Are we living in a simulation? How could we ever tell?
  - Artificial intelligence and consciousness
    - heartbeeps
      - Robots in love
    - Star trek the next generation
      - Data
    - Star trek voyager
      - The doctor
    - Star wars Episode II: attack of the clones
      - Well if droids could think there'd be none of us here, would there? - Obi-Wan Kenobi
  - Threat of Artificial Intelligence
    - Threat different based on culture
    - Astro boy
      - Started look of anime
      - Robot superhero
      - The japanese are less scared of AI and robots
    - The Terminator
      - skynet
      - Terminators
    - War games
    - 2001: A Space odyssey
    - I, Robot
      - Asimov's three laws of robotics
        - A robot may not injure a human being or through inaction allow a human being to come to harm



- A robot must obey the orders given to it by human beings, except where such orders would conflict with the first law
  - A robot must protect its own existence as long as such protection does not conflict with the first or second laws
- Transcendence
- AI rights
  - Ethical agents, ethical patients
    - Ethical agents: is something that can make moral choices
    - Ethical patient something you need to be good to animals, people or maybe rivers etc
  - Pain and suffering
    - Identity theory
      - For example dont believe animals feel pain because dont have same brain structure as us
    - Functionalism
      - For example believe pain can be realized by many different things
  - Blade runner
    - Only experts can tell the difference between replicants and humans

## **2018-03-27** Why cognitive Science is the most important thing in the world

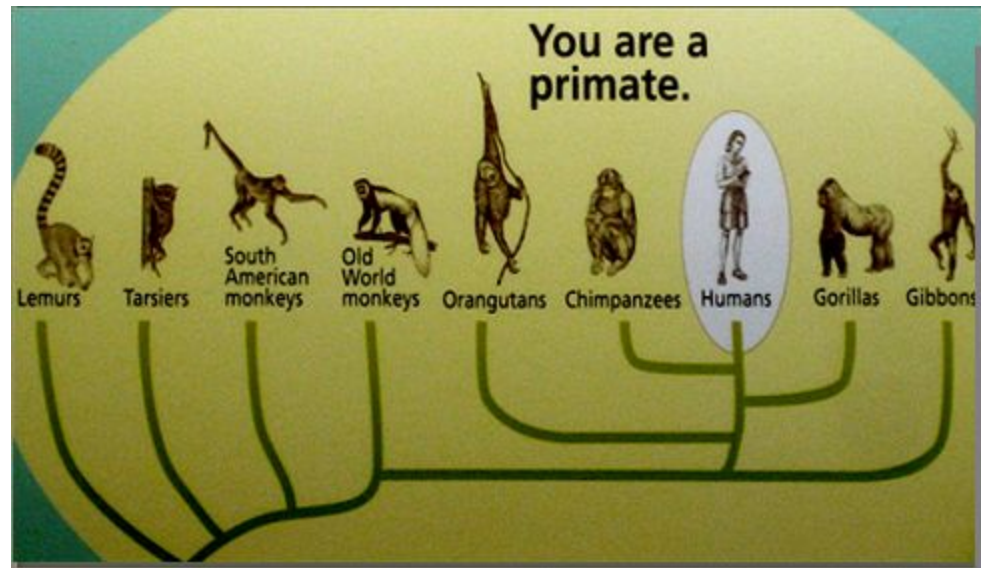
- What is important?
  - Making the world better
    - Part of that is reducing problems
- What are the world's problems
  - Problems on the decline
    - War and torture
    - Crime
    - Starvation
    - Disease
    - Short life span
    - Inequality
- Problems getting worse
  - Environmental damage
  - Social capital ( how much time we spend with others)
    - Read bowling alone by robert putnam
      - People spending more time and more time

- How do we fix climate change
  - Reduce carbon emissions
    - Technological solution come up with an alternate safe energy source
    - Fund science and engineering to do it
    - Get more people to care so our representatives will make it happen
    - Market the problem
    - Get money to market the problem
      - How?
- All problems are intellectual
  - The reasons we can't solve all the problems in the world is ultimately because we don't know how to do it
  - Figuring out how to do it requires thinking and problem solving
  - Guess what field is best suited to study thinking and problem solving?
    - Eg artificial blood vessel
- Cognitive Science and problem solving
  - The human modeling side of cognitive science studies how people actually solve problems and all of the other cognitive functions it takes to do it
  - The AI engineering side of cognitive science tries to make programs that can solve problems for us often better than us
- Ways AIs are better than us
  - Stock trading
  - Arithmetic and statistics
  - Scheduling
  - Search engines and aggregating
  - Many games
- Ways we are still better than AIs
  - Language
  - Physical movement
  - Creativity (arts, science, etc)
  - Science
  - Social interaction
  - Vision
  - Many games
  - Most everyday tasks
  - However AIs and other programs can make humans more effective used as tools
- Perhaps cognitive science can help us solve all of these problems

- Even if there is some other problem you think is more important you can apply cognitive science to the problem solving in that problem

## **2018-03-29 Social cognition and the evolution of intelligence**

- Evolution of cognition
  - What we know of our ancestors bodies come from fossils but there are two problems with this
    - Behavior is not fossilized
      - Thus we rely on scant artifacts but even those appear relatively recently
    - Fossils are very rare
      - It is thought that one bone in a billion becomes fossilized
      - That means for the population of Canada at 34 million, six of the human bones around today will end up getting fossilized
        - Bones not skeletons
      - And that's not even to say they'd ever be found. Human fossils are incredibly rare
- How long have humans been around
  - The oldest fossils of fully formed humans are only 50k-100k years old. That's only 2500-5000 generations of 20 years
  - If language is an instinct, like Chomsky says it is, then it probably had to have been evolving for longer than humans have been around since 50k years is not enough time to evolve language
  - Australopithecines had hands evolved for manipulation. We don't know that they didn't use tools
  - However only stone and metal tools last, most modern hunter-gatherer societies of today have more biodegradable tools than stone ones.
    - Stone age because we only found stone tools from then. But most of their tools might have been biodegradable and just disappeared
- Standard timetable for human evolution
  - We differentiated from something 100k-200k years ago
  - We differentiated from chimps much longer ago



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- We know this because a mitochondrial eve, which is the most distantly historical female that is the ancestor of all living humans
- She need not be human herself
- Mitochondria are weird they have their own DNA. they were probably once a parasite. (They were the inspiration for midichlorians in star wars)
- The oldest human fossils were found in africa, from about 100,000 years ago
- However some stuff found in zaire has modernish looking tools but they were dated 75k years ago
- This is like finding a car in da vinci's attic
- Most living things leave no record at all (no fossils)
- It is estimated that 1 in 10 thousand species ever get fossilized
- Most creatures dont die in sediment
- 95% of fossils are from marine creatures in shallow parts of the waters
- Difficulty in finding fossils
  - Keep in mind we share 70% of our dna with mice
- How did humans get so smart
  - Pinkers vision theory
    - Relying on vision is important because it is inherently 3D unlike olfaction
    - Olfactory animals such as dogs, keep their heads close to the ground much of the time
    - Its a two-dimensional flatland viewed through a one-dimensional peephole
    - 3D thinking requires more brain power

- Group living theory
  - Dunbars paper that you read
  - Human lives differ from other primates mostly in terms of their social environments
  - We evolved smart brains to
    - Communicate important information
    - Keep track of everybody else and maintain social relationships
    - Results in a social cognition arms race
- The hand/walking upright theory
  - Walking upright allowed us to exapt our hands for different functions which could make good use of more intelligence
  - Hands allow us to carry things, which allows us to create complex objects with parts from different geographical areas
    - Requires planning, imagination, working memory
  - These things work in a positive feedback loop
  - However there is no evidence of artifacts from the million and a half first years of bipedality
  - There are 12 theories of why humans became bipedal
- More on upright posture
  - Upright posture puts pressure on pelvis to be small
  - To maintain the intelligence arms race, evolution discovered a different strategy of altriciality
  - Altriciality means more infant care by parents
  - More infant care mean more male attention and pair bonding
- Hunting theory (ecological hypothesis)
  - In general carnivores are more intelligent than herbivores
    - It takes more brains for a wolf to hunt a rabbit than for a rabbit to hunt a lettuce head. Mental map size
    - Meat is nutritious. Relying on meat allowed brains to trust that nutrition will be in the environment allowing brains to grow bigger
    - Big kills encourage socialization
    - Meat from a wild bull can feed 1000 people. Make a deal with your neighbors so they'll share with you when they get lucky

## 2018-04-03 Cognitive Science and the Real World

- Law: false memory

- False memory is when people mistake suggestions by an interviewer (scientists, policeman, or therapist for example) as actual memories
  - Given a bunch of words to remember (doctor, medicine, nurse), then asked what words on it and might remember something like hospital
  - Can be implemented might remember stuff you didn't actually happen
  - Lost in the mall scenario
    - People brought in interviewer talks about the person's childhood then asks if you remember getting lost in the mall and an old women helping reunite you with your parents. People say i don't remember
    - Brought a few weeks later and again talk about lost in the mall scenario and then they “remember” and can talk about the old woman even though it is made up
  - Meeting bugs bunny at disney world scenario
    - Same as scenario above
  - There are lots of people in jail because of implanted memories of childhood abuse caused by well intentioned therapists
- Law: case based reasoning
  - Case-based reasoning (CBR) is an artificial intelligence paradigm that reasons about what to do by retrieving similar situations from memory
  - Lawyers need to find similar legal cases to the case they are working on
  - These can be retrieved by using a case, keywords or principles as a query
  - CBR has also been successful for help desks
- Medicine and AI
  - Diagnosis
  - Medical information
    - Retrieval
  - Image recognition and interpretation
  - Many are not used because they do not fit in with how the medical establishment works
  - Some of the earliest AI programs were made to diagnose patients. They are “expert systems” which are AIs intended to mimic the behaviour of human experts
- Human computer interaction HCI
  - Usefulness
    - How effective is the computer/software at what it is supposed to do?

- Usability
  - How easy is the software to use
- Learnability
  - How easy is it to learn how to use the software?
- Politics metaphor
  - George Lakoff has a popular theory that we think about abstract concepts as metaphors with more basic usually bodily concepts
    - Love is a journey characterized by the relationship was not going anywhere
    - Left wing sees the government as a strong father figure
    - Right wing sees it as a nurturing thing
  - His book Moral Politics describes how conservatives use a strict father metaphor of government and liberals use a nurturant parent metaphor
- Consumer behaviour behavioural economics
  - Classical period: economics allied with psychology
  - Neo classical period view that humans were rational: homo economicus or rational man assumption
  - Psychology and cognitive science influence (beginning with Tversky, Kahneman and Herbert Simon) shows the flaws in the homo economicus
- Watson playing jeopardy
  - Part of a tradition of game-playing AIs
  - What would a program need to be able to do to do what Watson did
- AI Playing Chess
  - They make a lot of counterintuitive even absurd looking moves that on closer inspection can turn out to be outrageously creative. By generating countless new ideas they are expanding the boundaries of chess enabling top players to study the game more deeply, play more subtly

## **2018-04-05 Cognitive Science Myths**

- We only use 10% of our brains
  - We use all of our brains
  - If any part of your brain gets damaged you will suffer deficits
  - Evolution would not waste energy building vast parts of your brain you don't use
  - Brain uses 20% of our energy, brain is 2% of our body mass
  - Why would we believe that?
    - Availability cascade
    - Wishful thinking
      - People like to believe in the paranormal

- People want to make money from you
- What is true
  - People can lose whole hemispheres and still function relatively normally
    - The brain has redundancy: if part of your brain gets damaged other parts of the brain can pick up the slack and still do things
    - Some people can lose entire hemispheres and it's barely noticeable
  - If we removed 70% of your neurons randomly we're not sure how badly off you would be
- Psychic powers are real
  - Unfortunately its not
  - There are several cognitive biases that make us believe that its real
    - Confirmation bias
    - Neglect of negative results
    - Wishful thinking
- Listening to Mozart makes babies smarter
  - We believe it because we hope its true
  - The effect is small short term and only based on arousal
    - Basically music makes kids more aroused which makes them interested and slightly smaller for a few minutes
  - You can get the same effect from hearing a scary passage from a Stephen King book
- IQ tests are biased
  - If they were biased they would underpredict later success for certain groups, and overpredict for others. This does not happen
  - Huge panels of scientists with widely varying viewpoints concluded that they are not biased
  - Item analysis is used to identify bad test questions
- Happiness
  - Money and happiness
    - Money correlates with happiness until you are making about 75k per year (in our society), then it levels off
    - As you make more money you keep comparing yourself to people who are wealthier than you so don't really get more happiness
  - Life events don't affect happiness much
    - Winners of lotteries and people who became paraplegic have happiness changes that only last months



- Things that do affect us: divorce, getting fired
  - Much of your happiness (roughly 60%) is genetic
  - There are two kinds of happiness
    - Pleasure day-to-day
    - Life satisfaction
- Childhood abuse leads to psychological disorders
  - Its very weakly correlated 0.09 (close to 0)
  - A conflict-ridden is much more likely to cause anxiety, depression, eating disorders etc
    - Maybe not beaten but have a lot of tension/conflict in the house can be bad for you
- Artificial intelligence is a failure
  - Moving goal posts: mysterians
    - Mysterians: as soon as its implemented on the computer dont call it AI anymore
  - Almost implemented
  - Our economy would probably collapse without the findings of AI researchers
- The full moon makes people act differently

○

	Aggressive behaviour	Normal Behavior
Full moon	People act aggressively when there's a full moon	People act normally when there's a full moon
Not a full moon	People act aggressively when there's no full moon	People act normally when there's no full moon

- Confirmation bias
- The bankrupt gravity explanation
  - Moon's gravity affects the tide so it must pull on us because we are mostly water
  - A mosquito on your arm has more gravitational effect on you
  - The fact that you are mostly water has nothing to do it
- Which quadrant are you most likely to notice and think of the moon effect? (top left)
- How science works
  - Generation of a theory

- A theory is an explanation that typically suggests the existence of theoretical entities that cannot be measured directly
- Theories make predictions about the real world
- These predictions become hypotheses that can be tested with experiments and quasi-experiments
  - Experiments have control over participants and conditions. They manipulate something
  - Quasi-experiments are observations in the real world. Most political science lessons are learned from quasi-experiments
    - Can't hit someone's head to see how they perform. Instead wait and test for someone to get brain damage and test them. Not perfect because can't control the dmg. Usually because doing an actual experiment is unethical or expensive
    - Just wait for it to happen in the world and observe it
  - Example theory: gravity, hypotheses if I let go of my keys they will fall to the ground
- Results and statistics
  - Hypotheses and falsifiability
  - Significant means probably not due to chance  $<0.05$  is the typical threshold or "alpha level"
    - This means that 1 out of 20 experiments will turn out finding significance just by chance
  - We can't look at a huge list of numbers and know if they are different that's why we need statistics
- Science as a culture
  - Replicability
    - Ability to run the same experiment and get the same results
  - Science's self-correcting nature
    - Publishing makes it public
    - Other scientists will attempt to disprove your theory. This is good
  - Science as an epistemology
    - No other knowledge-generating enterprise (e.g. religion) has a rigorous self-correcting mechanism

**2018-04-10**

- Pre history of cognitive science
  - 400 BCE ancient Greek philosophers made theories of mind
    - At this time science had not yet been invented

- Little was known about the world these guys philosophized about a whole lot
  - This is also the pre-history of all disciplines
  - Philosophers dominated the prehistory until about 1800
- 1800 birth of psychology
  - Psychophysics relationships between perception and stimuli
  - 1875 wilhelm wundt opened the first psychology laboratory
  - Ebbinghaus did some of the first experiments in memory
    - Both germans
    - Did a lot of experiments on himself
    - Read a list of words and saw how easy it is to remember if he reads it once, twice etc how much he can remember after a month etc
  - 1890s freud and the case study technique william james published principles of psychology which is still often quoted today
- 1913 behaviourism
  - 1908 pavlov's salivating dogs experiment
  - 1913 john watsons manifesto for behaviourism published
    - Held that we cannot directly study mental processes only stimulus and behaviour
    - In response to case studies and introspection
    - Tried to make a psychology like physics
- Chipping away at behaviourism
  - 1930 jean piaget
    - Learning stages hard to example with behaviourism
  - Problems helping pilots who were already experts
    - Pilots that were very good and highly trained. Psychologists were asked how to fix it.
  - Behaviourism started to try to explain difficult things such as language
    - Bf skinner tried to write a book about how humans learn language only through language. Wasn't a good book and might have been the end of behaviourism
    - Chomsky wrote a review about how bad the book was laid down foundations of modern linguistics
- Early 1900s cybernetics
  - Analog brain modeling (pre-computer)
  - Inspired by collaboration of psychologists working with engineers and communications people in war efforts
  - Was killed by artificial intelligence but made a bit of a comeback with neural networks

- Pre computers
  - Charles babbage
    - 1821 difference engine mechanical calculations
    - Analytical engine (never built)
- 1940 early computing
  - Turing test
  - Satisficing
    - Idea pick the idea that is good enough satisfy and sacrifice
    - Computers didn't have time to calculate all possibilities
  - 1955 birth of artificial intelligence
  - Part of why AI was needed for the birth of cognitivism was because before we had computer programs it was hard to imagine how information processors could work
- Birth of cognitivism
  - 1957 noams chomsky review of bf skinner's verbal behaviour
    - A book review more famous than the book it was reviewing
  - Introduced concepts
    - Poverty of the stimulus
      - Idea that kids don't hear enough to give them full information to learn a language so must be born with something to know about language
    - Universal grammar
  - Chomsky is still alive and working
- TOTE
  - Miller galanter pribram 1960 book: plans and the structure of behavior
  - Test operate test exit
    - Iterative problem solving strategies
- Late 1950s first neural network theory
  - Perceptrons neural network with one neuron, multiple inputs, one output
  - Killed in 1969 by perceptrons books by minsky and papert
- 1975ish
  - Developmental and computational linguistics
    - How people learn another language and over time
    - Computation is getting robots to understand language
  - Fodor's the language of thought
    - How the mind probably works
    - Idea that the mind talks in its own language not your first language
      - Some proof might be tip of the tongue
  - Robots

- 1980
  - Expert systems case based reasoning
  - Brain imaging
  - Neural net revival with backpropagation
- 1990s
  - AI getting more mathematical
  - Psychology decade of the brain
  - Philosophy paying more attention to empirical research
  - Expert systems decline
  - Embodied and situated cognition
    - Idea that some of our cognition is influenced by how our body looks like ie human not an elephant, up is good down is bad
    - Situated cognition where you live and how you interact with your environment around you
    - Situated in an environment that they are interacting with
- Cognitive science present
  - Strong cognitive science society
  - Conference is growing in size
  - Handful of cognitive science departments around the world
  - Neuroscience a big player
  - Lots of subdisciplines breaking off
- The singularity is a hypothetical time when AIs surpass human intelligence
- It is so named because of black holes which have a singularity that information cannot get across
- Ray kurzweil
  - Believes computer programs will be smarter than people around 2045
  - The singularity and why its called that
  - Kurzweil has a very optimistic view