Cognitive Processes - Todd Handy

January 5 - **Intro**

- What are cognitive processes?
  - Napoleon Dynamite clip
    - beyond language and what humans do mentally...
      - memories, emotional responses, attention issues/perception, knowledge
  - Cognitive processes are the parts, pieces and operations of mind. They concern how we 'represent' information in our minds, and how this information guides our thoughts and actions.
- Why study this stuff?
  - interesting for dem geeks, practical value

- Exam organization
  - 3 non-cumulative exams, equally weighted
    - Part 1. Lectures 1-8: Mental Representation. Exam Feb 2
    - Part 2. Lectures 9-16: Individual Cognition. Exam March 13
    - Part 3. 16-23: Social Cognition. (Exam during final exam period)
  - Format
    - 10-14 m/c questions (1 point each)
    - 12/14 short answer questions (4 points each)
      - 2-4 concise and direct sentences!

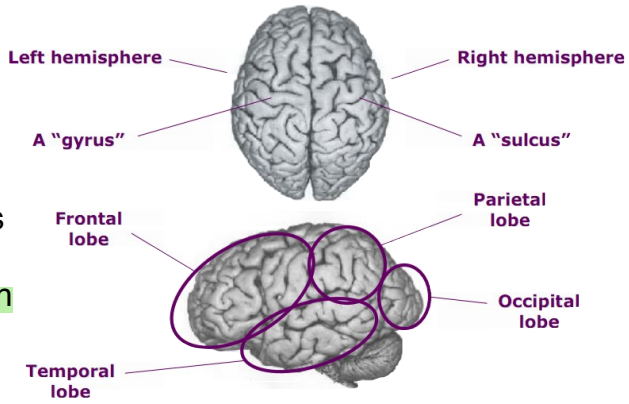
- Some tips
  - performance not about memorizing - about critical thinking, and putting things together!
  - read the articles before class, generally = EXAMPLES of concepts discussed in class

January 10 - **Mental Representation**

- What are "Representations"?
  - Things that symbolize or represent other things
    - ie. Vancouver 2010 Olympic Rings and Inuqshuk - the rings represent the Olympics, but they *aren't* the Olympics
- Representing Information in the Brain
  - In our minds/brains we represent *information* about ourselves and our external environment
    - hearing Todd lecture = representing sounds in brain
    - everything you are aware of internally or externally, that will be represented in your brain
  - Neurons are the representational medium in the brain
    - a cheeseburger as it exists out in the world is "represented" by neurons allowing you to "see" it
  - We represent different kinds of information in different parts of the brain

- different parts of the brain do different things
- math, vision, language, memory, emotion, pain, body parts, sense of self

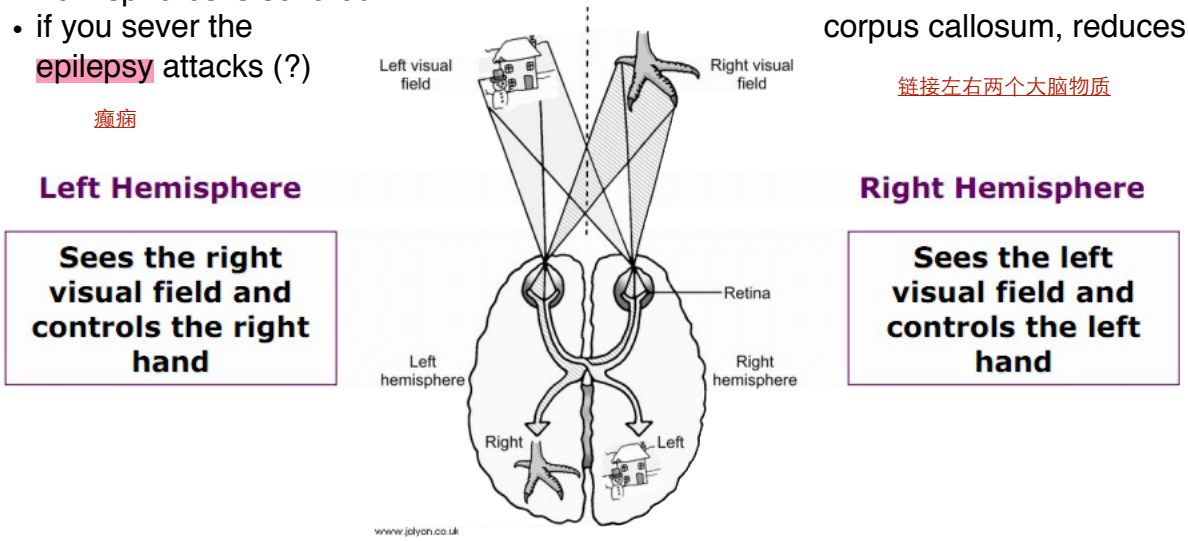
- The brain is flexible in terms of where stuff can be represented
  - Language: capacity for spoken and written language, our species developed spoken language long before humans can write
  - Writing/reading is not natural for our species and it takes effort to learn, but letters visually represent our auditory language
  - Braille: a sensory representation of our auditory language for those with visual impairments
- The BrainPort
  - Representing vision and other senses as braille-like bumps
  - Woman damages vestibular system, doesn't have balance
    - mounted balance on her head, hooked up to pad with braille-like grid placed on tongue
    - the grid stimulates her tongue by buzzing in relation to the balance on her head
    - allows her to process which way she was tilting, ultimately restoring her balance



- Basic Anatomy of the Brain
  - Left and Right Hemisphere
  - Occipital lobe - represents visual (ever see stars when you're hit in the back of you're head?)
  - Temporal lobe - auditory, vision - recognition with faces
  - Parietal lobe - motor, body function
  - Frontal lobe - thinking, decisions, conceptual sense of self
  - "Gyrus" bumps on brain (plural "gyri")
  - "Sulcus" crevices on brain (plural "sulci")
- Split-Brains
  - The consequence of a callosotomy, where the connections between the two hemispheres is severed
  - if you sever the corpus callosum, reduces epilepsy attacks (?)

链接左右两个大脑物质

癫痫



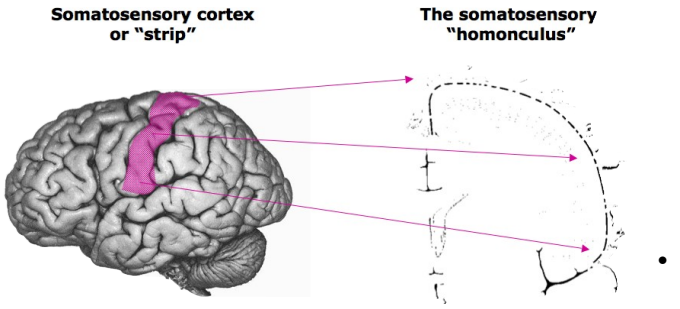
- Split Brains Video clip: example of how the brain's two hemispheres represent different kinds of information RE-WATCH CLIP AND RE-SUMMARIZE
  - Joe has surgery to correct epileptic problems, now has two brains
    - Surgeons cut corpus callosum, controls epilepsy, but has no connection/communication between the left and right hemisphere now
  - Normal person, right side of brain controls left side of body, left side of brain controls left side of body = difficult for a person to draw two separate pictures at the same time (one with each hand)
    - because the two halves of the brain are connected it is difficult to get the hands to work independently - the motor messages for one confuse the other
  - Joe, person with split brain, each hemisphere works independently = he can complete the drawing task successfully
    - each half of the brain sends independent instructions
  - When Joe is asked to say the words he sees on the computer screen, he only reports words on the right side of the screen
    - Ability to speak resides almost exclusively in left hemisphere of the brain
    - He was not able to speak the words on the left side of the screen, but the right hemisphere allowed Joe to draw them
      - For Joe, the communication does not occur inside his head, but outside on the paper as he draws
  - Left hemisphere recognizes speech, both hemispheres recognize reading
- Split Brains Video clip: Which hemisphere represents faces?
  - Ability to locate faces exclusively in right hemisphere
  - Study: show Joe the same painting (of a bunch of fruit that forms a face) to each hemisphere and see what he recognizes
    - First painting, goes to right hemisphere, Joe points to face
    - Second painting, goes to left hemisphere, Joe points to fruits
- Split Brains Video clip: Left hemisphere explains "cause and effect relationships" RE-WATCH CLIP AND RE-SUMMARIZE
  - Joe sees two words at the same time: music + bell
    - Joe points to the picture of the bell and the left hemisphere quickly reasons why he did this, even though there were other pictures that better represented 'music'
    - Talking about left hemisphere watching right hemisphere, but they show in the clip the voice over discussing the right hemisphere is discussing bell and pointing at it, but in the clip, the right hand points at the bell, so the LEFT HEMISPHERE was processing it
      - The left hemisphere explains things that are controlled by the right hemisphere

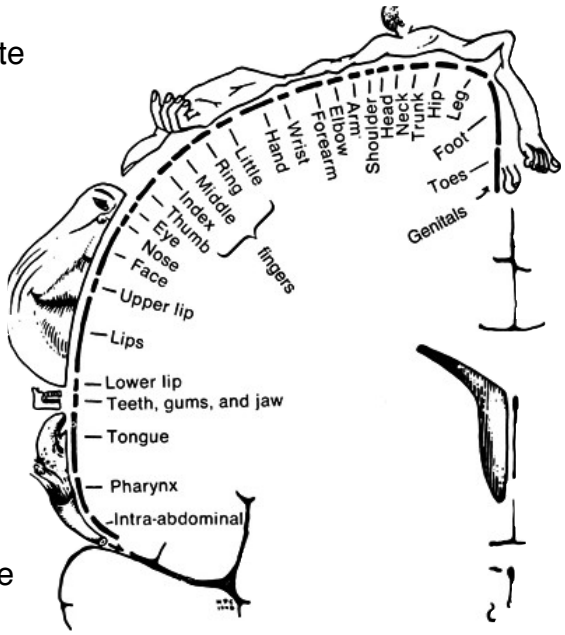
January 12 - **Body Representation**

- Basics of "Body" representation

Cognitive Processes - Todd Handy

- Skin sensations
- Disproportionate surface representations in the brain
  - Hands and mouth really sensitive
    - more tissue in brain devoted to these areas
- Clip: Pulp Fiction
  - Two hit men get in elevator
  - Talking about giving wife a foot massage, then a 'hit'
    - something sexual about a foot massage?
- Somatosensory cortex or "strip"
  - somatosensory "homonculus"
    - genitals right by feet
    - stimulating feet could begin to stimulate genitals



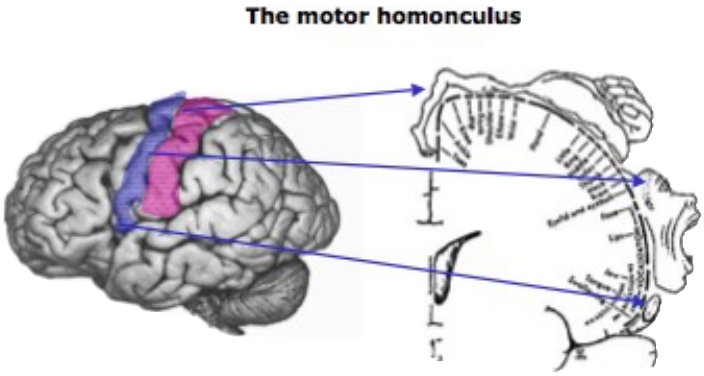


Neuroplasticity

- "Plasticity" refers to something that can be changed, re-formed, or re-molded
  - ie Michael Jackson plastic surgery
- brain function: ability of cognitive/neural processes to change and adapt over time
- Why do cognitive/neural processes change and adapt over time?
  - Learning: we can learn some things automatically and some things we have to work to learn, but our brain is capable of changing to learn
    - not plastic in the ways we sometimes need then to be to overcome things like disabilities
  - Experience: more learning through shared experience - explicitly vs implicitly, and memories
  - Aging/maturation: as you grow up body tissue changes
  - Brain/body changes: drugs fuck you up
- Clip: Phantom Limbs - example of cortical plasticity
  - Patient: Derek, motorcycle accident - told he was unable to use arm again (removed)
  - Derek could feel his arm still after surgery even though it wasn't there: phantom pain
  - when he shaved left side of his face, his missing hand would tingle

- experiment: q-tip drawn along his left jaw, Derek could feel a stroking sensation on his cheek, and his missing hand
- entire left side of the body is represented in the somatosensory cortex on the right side of the brain
  - representation of the face is right next to that of the hand
  - sensory signals normally only stimulate the face, but with the missing hand, the signals are misinterpreted and the 'hand' also feels things
    - cross-wiring of sensory pathways = neural pathways can change
- brain scan: missing arm could no longer send signals to brain, but sensory input for left side of his face took over
- can get phantom anything with the body except the brain
- Clicker: example of 'neuroplasticity' - derek feeling cotton swab on cheek and phantom limb AND derek's left cheek taking over the left hand area in his somatosensory strip

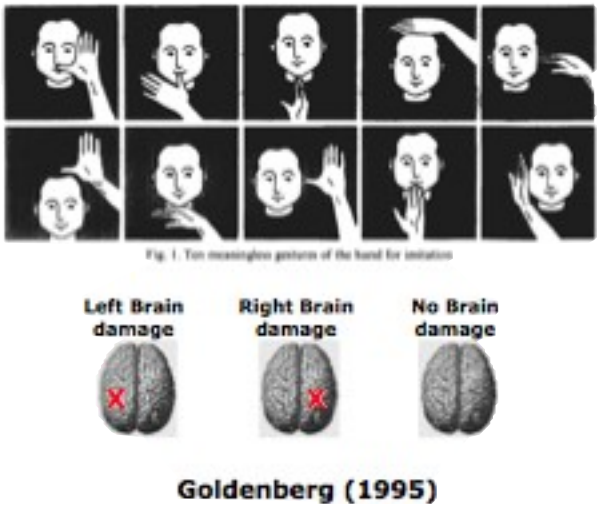
- Motor homonculus
  - body representations and movement
  - most sensitive in hands and faces, which is where we have the finest motor control



- Apraxia
  - Problems with representing how and where to move the hands
  - "How" to move the hands
    - an issue of learned motor programs
      - dialing a phone, turning a door knob
  - "Where" to move the hands
    - moving the hands relative to another body part
      - an issue of understanding body spatially
- Video Clip: Apraxia Patient - is her problem "how" or "where"?
  - She is asked to do different actions with her right hand
    - blow out match, brush teeth, dial telephone, hammering a nail etc.
  - She struggles "unlocking a door with a key" and she cannot signal traffic to stop, or blow a kiss (doesn't use hand)

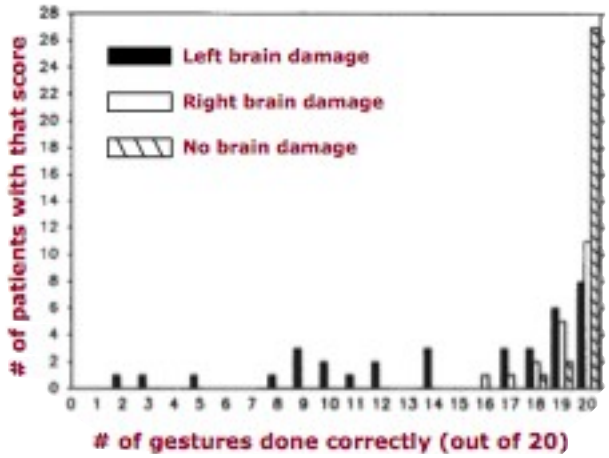
- She can touch all the areas of her body correctly
- Clicker: Her problem is HOW to move her hands, not where

- Where is “where” represented?
  - the ability to imitate simple, meaningless hand gestures was tested in 3 different groups of people



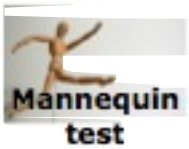
Goldenberg (1995)

- damage in left hemisphere, right hemisphere or none
- asked to do the hand gestures shown above



- “Where” is located in the left hemisphere as shown in the graph
- the right brain people might have a little issue because there still has been some brain damage, but they were pretty good at tasks overall

Where is "Where" Represented?!

Test	No Brain Damage	Right Brain Damage	Left Brain Damage (> 14)	Left Brain Damage (≤ 14)
 Mannequin test	17.9	16.2	16.5	8.0
	Score is average # of gestures correctly imitated on mannequin			
 Dexterity test	7.7	9.6	8.6	8.9
	Note: higher scores means "better" dexterity			

Goldenberg (1995)

- Test 1: the gestures were done on the mannequin instead of on themselves
- Test 2: no difference between groups in regards to dexterity
- CLICKER: What do these results tell us?
  - The problem LBD patients have is with understanding the spatial relations of all bodies, not just their own

January 17 - **Visual Representation**

- Implicit vs explicit awareness
  - Explicit awareness
    - representations that you are consciously aware of (can be tricked)
  - Implicit awareness
    - representations you are not consciously aware of
  - Titchener Illusion
    - The green circles are really the same size, but the one on top appears bigger

- The Aglioti Experiment effects explicit a lot more than implicit

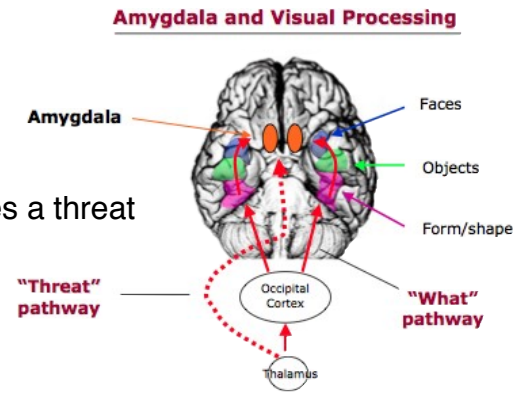
- Task: visually match size vs grab
- Results: bigger illusion for matching circles vs grabbing circles

- Dual Visual Pathways
  - in cortex, visual processing splits into two distinct pathways, each dealing with a distinct kind of representation
  - "What"
    - connected to explicit awareness
    - deals with object identification
    - Starts in visual cortex travels through Temporal lobe
  - "How"
    - connected to implicit awareness
    - helps integrate and incorporate visually guided movements
    - deals with behavior (ex how do I open this door?)
    - Starts in visual cortex travels through Parietal lobe
- Video clip: Optic Ataxia
  - A problem with "visually-guided" behavior stemming from impaired representations in the "how" pathway
  - Patient with optic ataxia given basic visual tests
    - She can see, she can identify objects, can tell the differences between objects, and know the relative distance between objects
  - She struggles with reaching and grabbing a small hammer
    - Damage with "how" pathway, when damaged movements are slower and less accurate
  - CLICKER: a neuroscientist and his colleagues meet patient with similar brain damage to lady with optic ataxia, when presented with a stapler, they should expect better performance on a task involving?
    - explicit awareness of visual stimuli in the environment
      - ex asking "what is this object"
- The Visual Agnosias
  - Seeing religious images in random objects
  - Pareidolia
    - seeing significance in otherwise "random" objects/stimuli
  - Different areas in the "what" pathway represent different aspects of visual objects
    - faces - prosopagnosia
    - objects - associative agnosia
    - form/shape - apperceptive agnosia
  - Apperceptive Agnosic
    - Patient had damage from carbon monoxide poisoning, damage to "what" pathway: presented tasks compared to 2 control subjects
    - Task: take a card and orient it to fit into the slot (matching angle of card to angle of slot)
      - she is not consciously receiving the right angle of the slot
    - Task: show width of tile by holding out two fingers

    - doesn't seem to perceive a difference in width between the tiles
  - Task: put card in the slot
    - She did pretty well, was similar to the control subjects
  - Task: pick up the tile
    - She does better than the control subjects
- Video Clips: Associative Agnosic
  - He's looking at and trying to identify a picture of a clarinet
    - first he thinks its a pen, then thinks it is a flute because he tried writing with it but couldn't
    - realizes he doesn't hold a flute like how he is holding the clarinet
    - manages to identify the object but with difficulty
  - He's looking at and trying to identify a picture of a combination lock
    - Patient convinced it is a telephone, is told to drop that idea
    - Asked what the size of the object is, and asked the relation in size to a cat and telephone
    - Realizes the dial is used for "dialing" numbers (why he is stuck on the telephone idea)
    - When given the choice between clock, lock, and telephone, he immediately says "Lock" but he isn't sure as he doesn't recognize it
    - his hands know the movements, and finally he says "combination lock"
  - Test to see how he recognizes actual objects: what does this tell us about object recognition?
    - apple - recognized
    - candle - recognized, but it smells like a crayon
    - pipe - recognized
  - fails to associate what he is seeing with conceptual ideas about the object
    - he has a representation of them in his brain, he just can't recognize them through photos
  - he is able to associate what he is seeing with actual objects
    - he can integrate other information to help him identify
  - CLICKER: summer of 2007, patient GT is hit by a car and suffers damage to her parietal lobe. As a result, she might experience:
    - optic ataxia due to damage to the "How" pathway

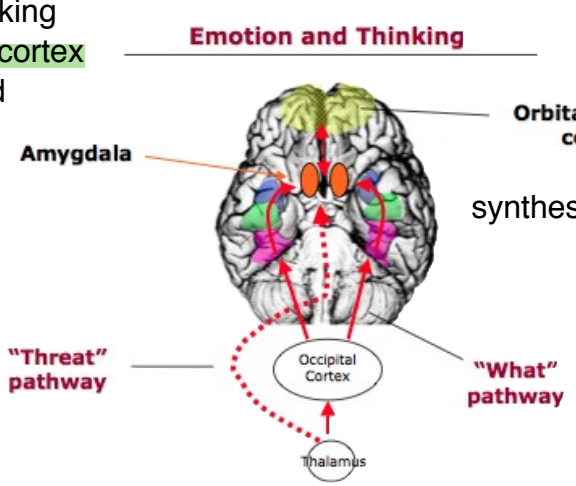
January 19 - **Emotional Representation**

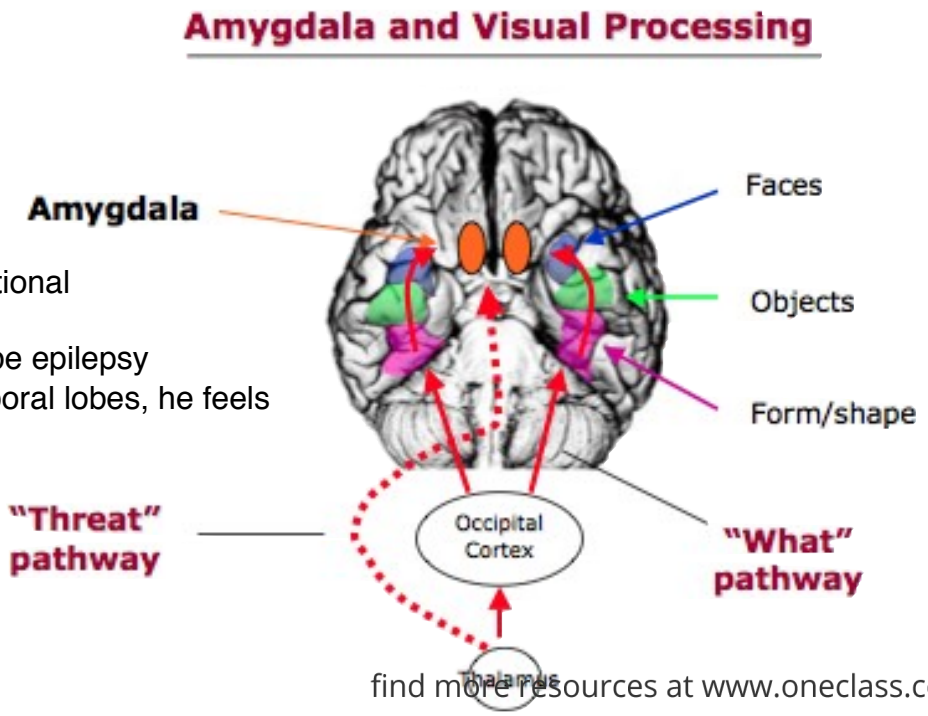
- Threat Responses
  - Implicit threat detection
  - Video Clip: Napoleon Dynamite
    - Uncle Rico screams
      - is reacting to a threat - first have to make a judgement as to whether or not the situation poses a threat
- Amygdala and Visual Processing
  - Two ways that visual information gets to the amygdala



- "what" pathway
  - slower
- "threat" pathway
  - faster (goes right from thalamus)
  - proposed pathway for emotion blindness

- Amygdala
  - processing and memory of emotional stimuli
  - part of limbic system
- Video Clip: The "Threat" Pathway
  - a demonstration of "emotion blindness"
  - flashing images: did you see all the food items?
- Emotion blindness
  - something emotional happens, and you miss what happens right after the emotional stimulus "a blink"
- Emotion and Thinking
  - Orbital frontal cortex and amygdala are interconnected
  - Orbital frontal cortex
    - important in decision making
    - synthesizes information stimuli received

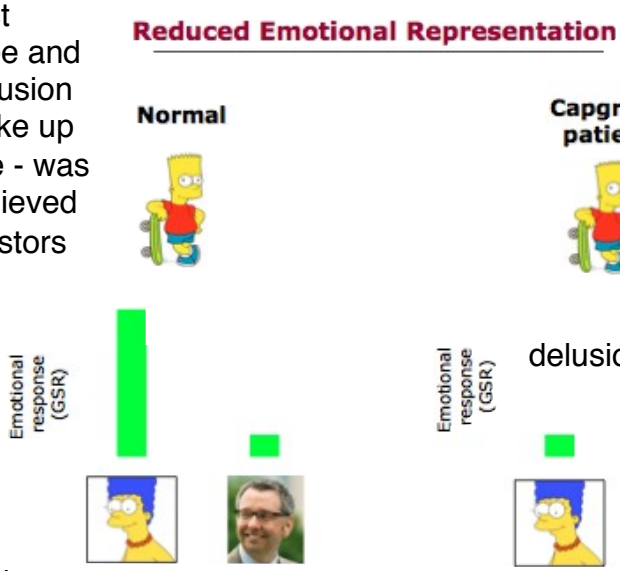




- Video Clip: Excessive Emotional Representation
  - Patient has temporal lobe epilepsy
  - 'electrical storm' in temporal lobes, he feels his body tingle

- got drunk in desert with gf, was hit with bout of seizures - unconscious, father picked him up
- aftermath of seizures: he feels omnipotent - everything is surreal, talks philosophy
  - he ran out of house shouting he was god
- had never been religious, but he became very spiritual because of his seizures and this 'knowing' that came with the conclusion of an episode
  - thinks he is a profit
- Pain: "I'd rather be whipped to death"
- Joy: "I feel like I can float"

- These symptoms do not happen to everyone
  - with extra 'firing' things that usually aren't that special are really significant
- Video Clip: Reduced Emotional Representation
  - Capgras' Delusion
  - David was in a car crash, suffered loss of arm, and lost connection between temporal lobe and amygdala, has capgras' delusion
  - when he woke up from coma, he seems mentally fine - was intelligent, cohesive
    - really believed that those close to him are impostors
    - Woman looked like mother, but wasn't her; he just 'knew'
  - David had delusions about people, and also believed that his house was an imitation
  - when you look at an object, message reaches temporal lobes, it is identified then it passes through gateway to centre where the emotional response is determined in the amygdala
  - auditory pathway to amygdala not damaged in David (so he is not delusional on the phone)
  - lack of emotional response leads him to believe that his mother is an impostor



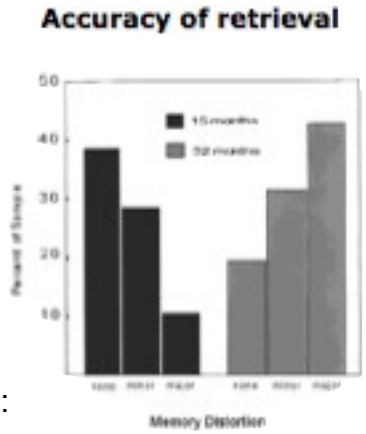
Jan 24 - **Memory Representation**

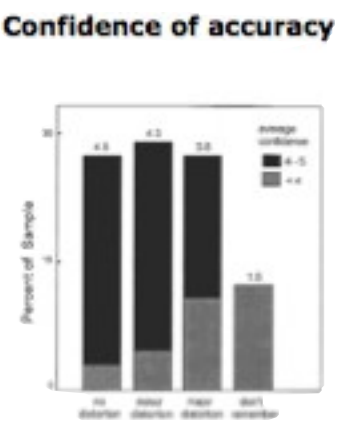
- Video Clip: Finding Nemo and episodic memory
  - A classic failure of memory - Dori's short term memory loss
    - if you damage the processes in the hippocampus it becomes difficult to remember things short term
  - (another example: the movie Memento)
- Plasticity of Content
  - OJ Simpson, American football player, becomes a hero until he is blamed and pursued in car chase for his wife's murder
  - Flash-bowl Memory
    - ex. Where were you when MJ died?
  - Memory study about OJ Simpson
    - researchers told students to tell them everything about where they were when they found out OJ was not guilty, 3 days after verdict
    - students contacted years later to see how significant memory change was after time
    - Results: our memories are failing us over time

- CLICKER: How confident are you that your memory of where you were when you first heard that planes had been flown into the World Trade Center on 9/11 is accurate?

- (I am) Extremely Confident - there is a divide though amongst the class, some don't remember

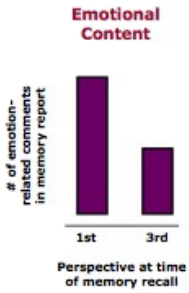
- Plasticity of Perspective
  - we can recall memories from more than one perspective
    - First-person perspective
      - seeing something from your own eyes
    - Third-person perspective
      - we have capacity of seeing things like we are watching ourselves in a movie

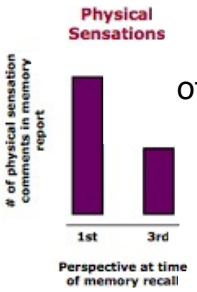




    - CLICKER: recall your high school graduation, or some similar life event. Can you see or relive that event in your minds eye from either a 1st or 3rd person perspective?
      - I can see it from both a 1st and 3rd person perspective - as can majority of the class
    - Study: brought people into the lab on the first day to do 4 tasks
      - walk around UBC campus, make a piece of art, play a game, make a dessert
      - brought people back week later and put them in MRI scanner and memories of the tasks recalled from a first or third person perspective, verbal reports of what they remembered also recalled
      - Results

- Video Clip: Memory for Facts
  - Semantic dementia patient, manifests the inability to use words to express what she is thinking
    - what extent does this have on the ability to think?
  - another video, same woman asked to pick up objects, she got some mixed up
    - asked to pick up scissors and she picked up a pen
    - eventually got the task right
- Plasticity of Retrieval
  - CLICKER: When studying course material for an exam, how often do you test/quiz yourself?

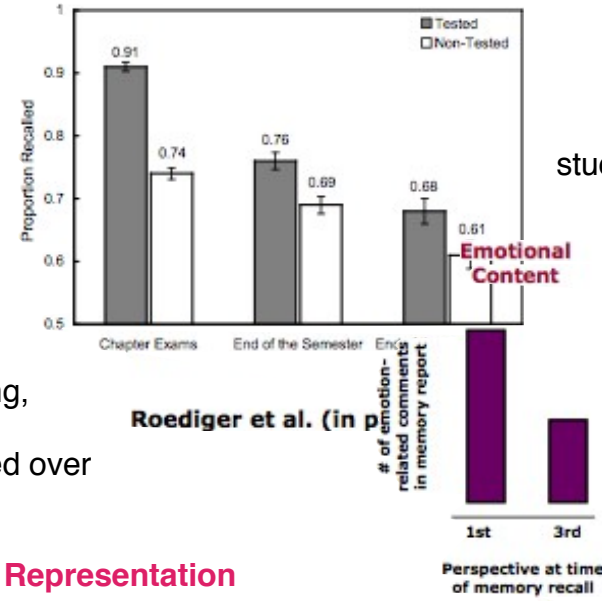


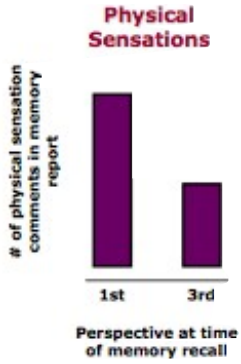


Eich et al. (2009)

- majority of the class answered “occasionally”
- Study: effect of retrieval on fact retention
  - 6th, 7th, and 8th grade science classes
  - some facts on each lesson are quizzed three times; comparable facts are not quizzed
    - consider recall on tests at ends of chapters, end of the semester, and end of year
  - Results: testing improved retrieval/retention

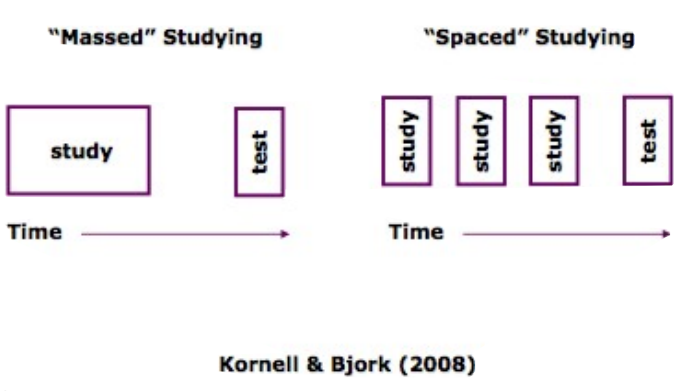
- Does spacing out study sessions matter?
  - Yes, students with 3 spaced out study sessions outperformed “massed” studying, but the “massed” students improved over time

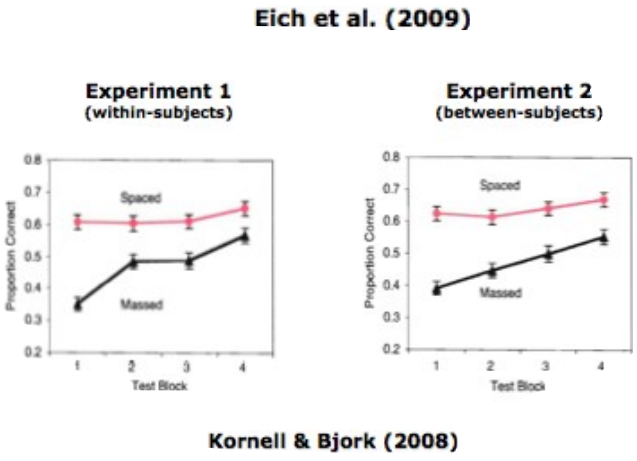




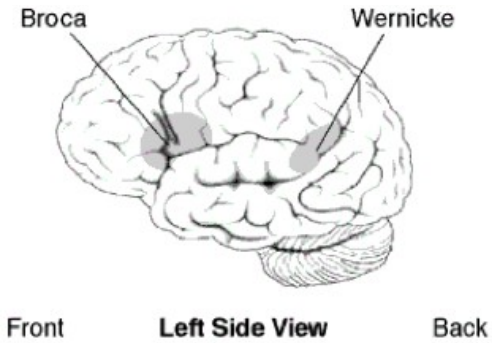
LECTURE 7 - **Language Representation**

Language and the Left Hemisphere





Cognitive Processes - Todd Handy



- Broca and Wernicke's Aphasia
  - Broca studying a patient who had problems generating speech, made sense but had no fluency
    - found to have damage in the frontal lobes
  - Wernicke was studying a patient who maintained the fluent sounds of speech, but the content made no sense
    - had damage in the upper temporal lobe
- brain areas associated with fluency and meaning of speech

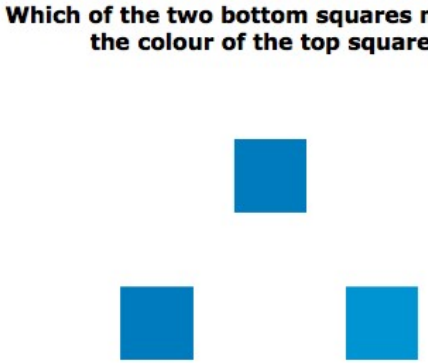
Dissociating Representations

- video: patient who has alexia (inability to read) without agraphia (inability to write)
  - independence of representations in the brain
  - is shown the work "key" and cannot read it, cannot even decipher what the letters are very well
  - she can write when she is asked to
- video: patient with anomia (inability to name names)
  - she is asked to name a saw
  - she knows what it is and what it is used for but just can't say it
  - she knows it starts with an s
  - unsure of whether it is all anomia or some averbia (trouble saying verbs)
- video: a loss of grammar
  - patient who had a stroke, used to have a law practice but could not longer be a lawyer
  - lost his ability to understand language and express himself
  - when he speaks it is almost incomprehensible
  - he has the verbs fine, but he has lost everything else in terms of his ability to comprehend
  - his problem is more comprehending that speaking, he can speak it is just pretty slow

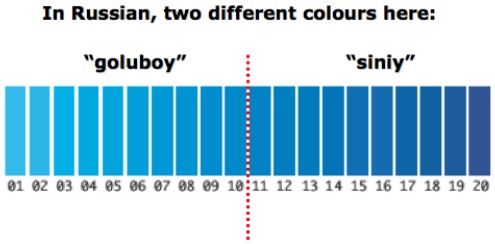
Language and Cognition

- Sapir-Whorf Hypothesis
  - the language you speak affects the structure and organization of your mental representations

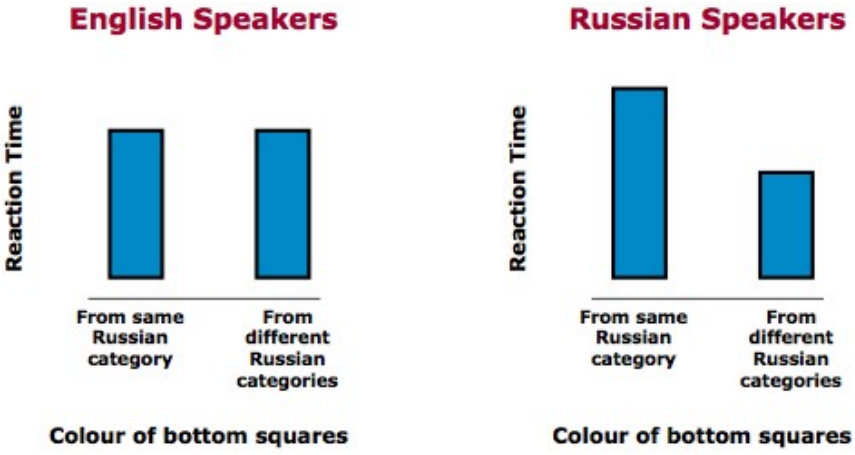
- Language/Vision Interactions
  - Test of whether the upper square matches the left or right bottom square



  - how does language impact what we see?
  - russian speakers have two different words for blue

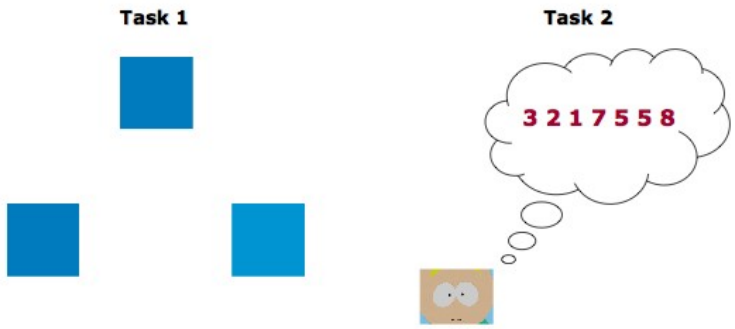


  - had native english speakers and russians do the task, to see if it altered the results when distinguishing between goluboy and sinly
  - experiment 1 results

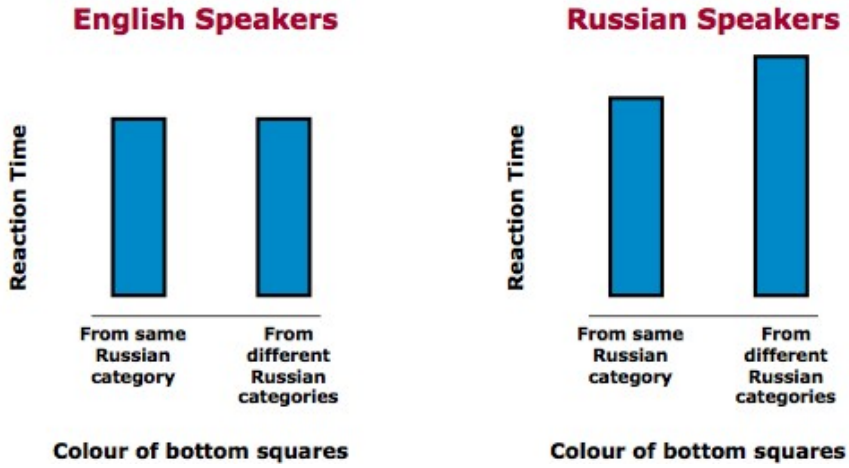


    - for the english speakers it didn't make any difference at all
  - experiment 2 results - control experiment
    - had people try to do two tasks at the same time (dual-task), have to be able to say the number after doing the task

Cognitive Processes - Todd Handy



- results



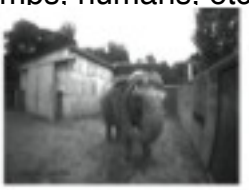
- it slows the russian speakers down more than the english speakers, originally they were quicker when they were from different categories

Clicker Questions

- the preceding patient could write words but not read them.How does this relate to VJ from the split-brain article for today?
  - they both suggest that reading and writing appear to be based on separate representations
    - ability to speak and listen evolved long before our ability to read and write
    - reading and writing tend to take advantage of whatever brain space is there, they are not necessarily linked to our ability to speak
- the preceding patient could tell you all about saws, but could not name it. what does this tell us?
  - representations of object names and object details are distinct or independent
    - semantic knowledge of objects is separate from names of objects
    - there could be a patient who knows what a saw is but can't tell you anything about it
- why this additional colour-matching experiment? what is it trying to show?
  - that language processes are actively involved in the identification of the colour by russian speakers

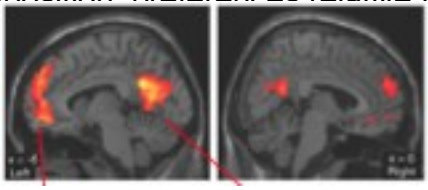
Jan 31 - **Self Representation**

- Self as a Conceptual Identity
  - Video Clip: Finding Nemo
    - Nemo in the Dentist's fish tank, meeting others for the first time
    - One fish thinks her reflection is her sister Flo
      - Mirrored-self mis-identification
  - Mirror Self-Recognition Test
    - How do you assess self-understanding of animals?
      - Stage 1: social response
        - treating the image as another animal/conspecific
      - Stage 2: Physical mirror inspection
        - looking behind the mirror
      - Stage 3: Repetitive mirror testing behavior
        - linking self-movements to mirror image movements
      - Stage 4: Self directed behavior
        - recognition of mirror image as self
        - passing the 'mark' test (draw on face, see if the reaction is towards the mirror or the self)
      - Dolphins, elephants, chimps, humans, etc have passed the test (have to have


ve)

- "Self" in the Brain
  - Where do we represent in the brain? (Ochsner 2005)
    - Medial prefrontal and medial parietal cortices activate when reflecting on aspects of the 'self'
      - ie your mood, disposition, preferences relative to when reflecting on facts, other people etc



- Self in Body
  - multi-sensory integration: different pieces (sight, sound etc) integrated in the nervous system and working together to give a unified experience of self

- Video Clip: Phantom limbs revisited, an example of how body representations interact
  - Patient in pain, phantom hand clenched and it is impossible to treat as there is no hand and the arm cannot give the brain feedback to make the pain stop
  - when we move, we generally have visual confirmation, tries to give patient visual sense that his limb is moving to 'unclench' it
  - used a mirror box to 'trick' the brain, and the study worked, and the patients pain was gone
  - shows pain is just a construct of the mind
- Supernumerary phantom limbs
  - feel like you have an extra limb, studies below patient drew what they felt
  - somatic sens
    - can feel it

Khateb (2009)

Staub (2006)

    - instead of feeling one thing, you feel as if it has split, and you feel both
    - we all have memories of what we have recently done with our movements
      - patient lost this ability, and has it repeated (she relives the moment creating this split arm phantom limb)
  - Video Clip: Misoplegia, or "alien hand syndrome"
    - dog is eating a bone, back paw moves (without the dog registering it)
    - dog is extremely aggressive towards its own leg, obvious he is not treating it as its own
- An Autoscopic Experience
  - Blanke (2004)
    - Patient felt out of his body but in a chair, then his body moved from the chair
- Self in Space
  - Lesion Analysis
  - Blanke (2004)
    - Patients with certain damage or electrical stimulation to parts of the parietal lobe can have out of body experiences
      - extreme fever, extreme exhaustion, drugs

Cognitive Processes - Todd Handy

- Self in Time
  - What day is it? Where am I? What time is is?
  - Aziz & Warner (2005)
    - Case 2: Every Day is Sunday
      - Patient went to Sunday church service every day of the week
      - she believed that every day was Sunday, and that the Daily Mirror caused every other day to be substituted for Sunday
    - Case 3: Eight Days a Week
      - Patient believed time had been interfered with and that Sunday occurred 2-3 times a week which interfered with her shopping
    - Case 1: Groundhog Day
      - Certain experiences in a day which she perceived as being repeated
      - made eating lunch at hospital difficult
        - especially tough piece of plaice eleven times