PSY 270 - Memory

HERA: hemis. enc. retriev. asym.
- L-PFC: encoding
- R-PFC: retrieval

Mem

- **Sensory** – large capacity, short dura° – raw data
  - iconic – 4/5 items – 1/4–1 sec
  - echoic – 1-4 sec.
- **WM**
  - STM – 7±2
  - central exec → visuo-spatial / episodic / phonological
  - 'multi-modal'
  - . slave systems
  - - LTM: prev. knowl.
  - 3 encodings: visual, aud., semantic
- **LTM**
  - Declarative (prop, explicit)
    - episodic mem
      - . flash bulb ✗
      - - autobio ✓
      - . hippocampus involved in encoding/retrieval but not storage
      - . MTL medial temp lobe
      - . perirhinal cortex activity → recogni° mem ↗
    - Semantic mem
      - double dissocia°, i.e. ep.-sem are stored in ≠ areas
  - Non Decl. (proc., implicit)
    - priming
      - . recogni° of prev. stimulus
      - ` recent trace
      - ↓
      - ⊕ prim. → recogni° speed ↗
      - . repetitive p. ~ word recogni°
      - . conceptual p. ~ concept recogni°
      - ⊖ prim. → S ⊕ prim
    - conditioning mem
      - . neutral stimulus affectively coloured
    - procedural mem
      - . skill mem
    - . familiarity effect
    - . propaganda effect

modal model

Sensory mem → (selective atten°) → STM (rehearsal (acoustic)) → (transf.) → LTM; LTM → (retriev.) → STM

levels of processing

shallow proc ~ sensing, 1st order

deep proc ~ understanding, 2nd order

e.g. shallow ——————→ deep

structure – capitalisa°; phonemic – homonyms; categoric – synonyms; sentence – filling gap

—→ effort not involved –

. consolidation: new mem fragile → stable
- . synaptic consolida°
- . systems ———

Std model (consol.):
- . during consol. hyppoc. involv. retrieval
- . after —— —— not inv. ——

as reactiva° occurs to strengthen cortical links

—→ explains graded amnesia

multiple trace hyp. ~ reconstructive mem
- . after retrieval of remote, reactiva° occurs that leads to reconsolida°

. maintenance rehearsal: maintain in WM, poor transfer to LTM → shallow proc.

. elaborative ———: varying depth of proc –
- . complex sentence: more links = more retrieval cues
- . forming visuals: ——
- . self-reference effect: ——
- . generating info: genera° effect
- . organizing info: categorising scenes as retrieval cue –
- . testing info: testing effect

. free recall (context) vs cued recall (context + applied info) vs recogni° (context + all info)

↳ more effective when self-generated

. matching encoding/retrieval conditions (≠ mem)
- . encoding specificity = env. context
- . state-dependent learning = internal mood
- . transfer appropriate proc = type of task

Recognition failure of recallable words

- sensitivity (good retrieval cues)

Ebbinghaus: savings = #initial trials - trials to relearn perfect. / #ini x100
#rep trials to relearn perfect. / #ini

in general: free recall < cued recall < recognition < savings

but Tulving Thomson 4 stage exp: 1. learn capital words in pairs glue-CHAIR
2. generate free assoc. table: dining chair,...
3. recognise target in generated: chair
4. cued recall: glue - ?

be nabelling of enc/ret cues even if not 'good' retrieval cue in general { not good → 3. ; good → 4.

=> if ~~bad~~ wrong retrieval cue, might not remember even if mem -

autobiographical mem

- specific experience ~ episodic vs personal fact - semantic
- multidimensionality
- A-photos vs L-photos: fmri shows A-photos (self taken) activate more areas
- reminiscence bump: ⌒ → age 10-30
- aka self-image bump: life narrative hypo: multiple identities during young adulthood
  - cognitive hypo: encoding better during periods of change
  - cultural life-script hypo: culture provides schema for life story
    → ↗ recall when both match
- flash bulb mem: vividness as event was highly emo°, false confidence
  - narrative rehearsal hypo: reconsolida° of flashbulb through media...
- method of repeated recall: 1st recall is taken as baseline
- reconstructive mem:
  - pragmatic inference: expect smthg from prev. knowledge
    → schemas & scripts
  - repeated reproduc°: Bartlett war of the ghosts
    → story was reconstructed based on culture
  - source monitoring: cause leading to forma° of specific mem
    - source monitoring error = source misattribu°
      → cryptomnesia: unconscious plagiarism
      Cliffons → G. Harrison my sweet lord
    → becoming famous overnight: familiarity effect → fame misattribu°
    → gender exp: if can't recall source, use stereotypes -

- misinforma° effect: misleading post event info influences recall
  - memory trace replacement hypo: MPI replaces / biases / impairs original trace through reconsolida°
  - retroactive interference: MPI interferes with original trace but original trace is still present
  - source monitor. error: MPI is identified as source of mem
    - → Lindsay exp:
      - correct story, female warrant.
        - → MPI female → misattrib errors from MPI
        - → MPI male → not signif w.r.t. control
  - post-event questioning increases confidence in mems
  - eyewitness stuff →
    - open ended quest, warn against guessing
    - lineup:
      - may or may not include criminal
      - fillers are similar
      - no feedback, blind lineup admin
      - sequential is better than simult.
    - cognitive interview
  - reverse testing effect:
    - → Chen exp:
      - story → cued recall - break → MPI → cued recall: 50% MPI err.
      - story → game - break → MPI → cued recall: 30% MPI err.
      - expl: reactiva° of fresh mems makes them more sensitive to being changed.
  - amygdala: activated for strong emotions.
    - → low attent° arousal: attend to irrelevant info
    - → high attent° arousal: narrow focus
    -) balance best
  - recovered mems: repressed mems ✓ vs false mems *
    - imagina° infla° paradigm:
      - → use autobiographical adds to affect autobio mems through reconsolida°
    - happening truth (bare facts) vs story truth (narrativiza°, script)
  - recons. mem redux:
    - encoding influenced by related concepts, schemas / scripts
    - reactiva° influenced by MPI
    - ⇒ impossible to: raw encoding, retrieval identical as encoding

Schacter 7 sins of mem:

- transience — fade w/ time
- absentmindedness — attention → encoding
- blocking — block, tip-of-tongue
- misattribution — source monitoring
- suggestibility — MPI
- bias — reconstruct
- persistence — hard to forget what we want

PSY270 - knowledge

. concept : mental rep. unit of symbolic knowledge
. category : rule to organize concept
. schemas/scripts : framework ——— } semantic mem

→ natural concept (plants, cats) vs artificial c. (computer) vs ad-hoc (things to be happy)

Categorisation
. definitional (featural) approach × necessary features pl
. prototype : average of prominent members ⇒ typicality gradient

multiple exemplars → average composites = morphed comp. ⇒ prototype ✓
→ explains fuzzy concepts
→ family resemblance : ↑ when many overlaps w/ prototype
i.e. # overlaps with members of category
→ typicality effect : {prototypical obj are {named 1st, faster
{more affected by priming
. exemplar : ≠ examples used instead of average
→ explains atypical cases ~ excep° : e.g. ostrich

→ use both prot + exemp → at first proto, later exemp.
→ for small categories → exemp, large → prot

. hierarchical organiza° ——→ global (animal)
normal knowledge → basic preferred
expert ——→ specific
(cat) (fish) basic ↑ lose big info
(egyp. cat) specific (salmon) ↓ gain small info

Relationship between categories
↓ 2. ~~network~~
. semantic network

. category specific impairment : e.g. double dissocia° between living/non liv.
. however evidence against :
in dictionary defs : living → more visual attributes
nonliv → more funct° ———
. ⇒ perceptual/funct° distinc° of semantic info
→ sources of knowledge for categories weighted ≠ cy

. Collins & Quillian : hierarchical sen. net.
skin, flies, sings | animal, bird, canary | sentence verif time
→ cognitive econ as parent stores info for all children
→ spreading activa° : traversed on adj. nodes are primed
. lexical decision task : bloag no, blant yes
→ falsified by typicality (e.g. pig animal ↓)

. Collins & Loftus : personal sen. net. → too general so not falsifiable useful

PSY 210 - Visual Imagery

. mental imag : mental rep of non present stimuli

. vis imag : spacio-visual rep. of env.

. cognitive role of visual mem

. Paivio paired-associate learning : boat-hat , mouth-justice

. easier to recall concrete vs abstract

→ conceptual peg hypo : image of boat helps recall hat (by imaging)

. Shepard mental-chrono : how much time it takes to do mental rotn

→ dual coding hypo : { images – analogue code ~ perception
verbal – symbolic code – arbitrary } – linked

→ concrete dual coded vs abstract single-coded
multiple traces

. shared mechs in percep ~ imagery : spatial layout correspondence

. Kosslyn mental scanning → imagery is spatial (depictive rep. real ↔ mental)

. Pylyshyn → spatial nature is epiphenomenal, underlying is propositional

. tacit knowledge explan (unconscious use of prop info about world)

→ also accounts for distance in mental scanning

→ refuted by ↑ : : → ↕ ? points to prev. dot
→ not enough time to encode distance

. Kosslyn size exps → imagine 🐇 vs 🐭, taker longer to notice detail when obj is far away

→ mental walk : longer for ⌐🚶 than for ⌐🚶

. Perky interference exp → present non conscious visual (dim image)

↳ mental image is affected by percep –

other exp → imagine H → presented w/ □,H or H,□ → 85%

Mental image primes perception ——— □,T or T,□ → 75%

. Linde associa°/size exp : wine, assoc, size

w – word stimulus cat-dog
i – image ——— o O

. part-whole relation ship info is limited in mental image

. Carmichael exp : ☼ + wheel = 🌞 , ☼ + sun = ☼ | images distorted by knowledge

. neuropsych

. unilateral neglect is also for mental images

. double dissocia° percep / imagery → percep is bottom-up then top-down.
imagery is top-down. adds order

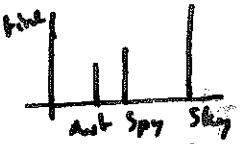
. practical men improv w/ imagery : → method of loci
→ peg word technique : combine loci with rhyme

PSY270 - Language

- Psycholinguistics : . comprehension
  . speech produc°
  . representa°
  . acquisition

from PSY270-Bunbar:
("The old man (,) the boat")

- words are stored in lexicon (adult lexicon ~ 50 k words)
  - phonemes : smallest contrastive linguistic unit which may alter meaning
  - morphemes : smallest grammatical unit, may or may not stand alone (meaning)
    - free morpheme : ship, truck
    - bound morpheme : ment, s
  - word : collec° of 1 or more morphemes
  - word superiority effect : Reicher exp : . FORK / . K / . RFOK | recognize K easier when FORK is presented : gestalt percep. > indiv letter proc.
  - word frequency effect : Rayner exp : measure fixa° (eye mov) for common vs uncommon words (percep. / semantic)
    - lexical decision task : recognize words from non-words
      → easier for common —



- lexical ambiguity : bug
  - lexical priming → semantic trace ; Swinney exp : 1 : hear bug then stimulus
    2 : hear bug, 2 ms later test.
    → when word used in sentence, multiple meanings are activated simultaneously but when context is given, single meaning remains
- parsing : . temporary ambiguity : A believed the sentence ... { was lying / when he spoke
  - garden path sequence : exploits temp. ambig K pragmatic inf -
    → cast IRON sinks ... quickly ... rust.
- understanding narrative : assuming coherence → inference -
  - anaphoric inference : X bla bla . She likes me —— She = X
  - instrument inference : Shakespeare wrote Hamlet —— used quill
  - causal inference : X took LSD. World is melting. —— LSD → World
- language produc° : communica°
  - semantic coordina° : given-new contract - provide known info before new.
  - syntactic —— : syntactic priming - the partner's syntax influences ours -
    - exp : ① read card / listen → ② listen / read card (structure in ② was constr. ①)

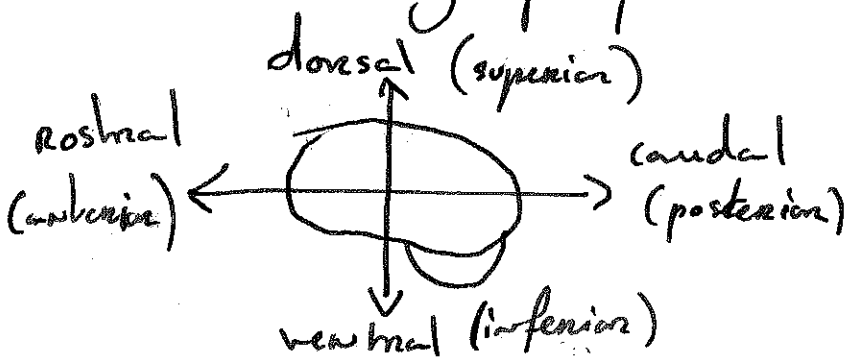
⇒ relinquish syntax to automatize to increase conv. fluency

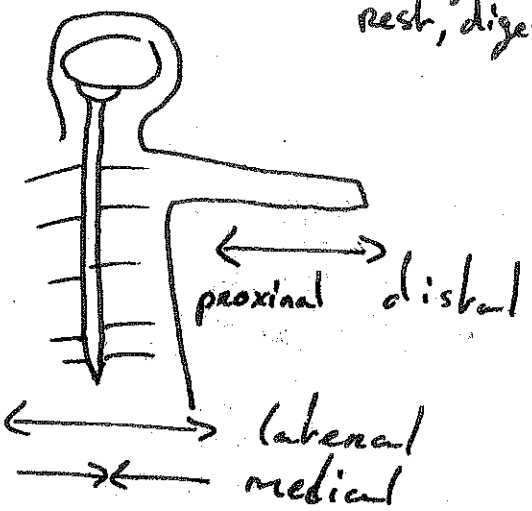
Cognitive Neuroscience

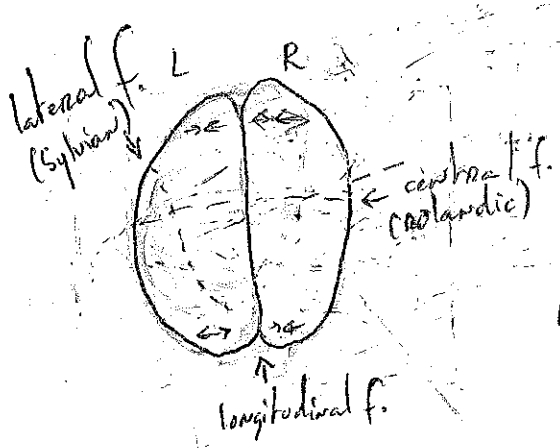
- Nervous System

- NS
  - CNS
    - brain
    - spinal cord
  - PNS
    - SoNS
      - ~~SNS~~ - efferent (motor neurons) → voluntary control
    - ANS
      - sympa (SNS) → involuntary control
      - parasympa (PSNS) → involuntary control
        - arousing "fight or flight"
        - calming rest, digestion

- Nervous Geography

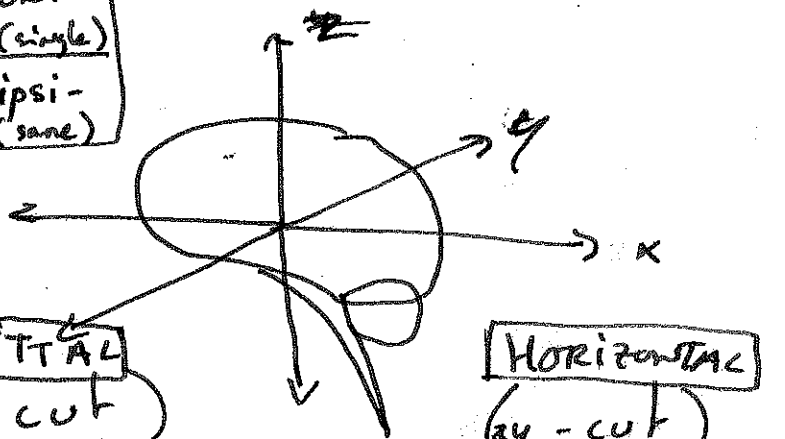




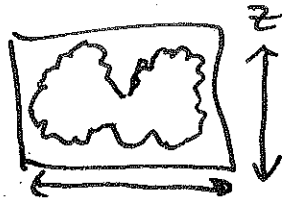


- lateral

bi- (both)	uni- (single)
contra- (opposite)	ipsi- (same)

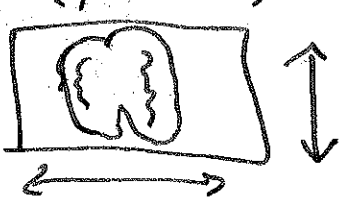


CORONAL (yz - cut)



SAGITTAL (xz - cut)

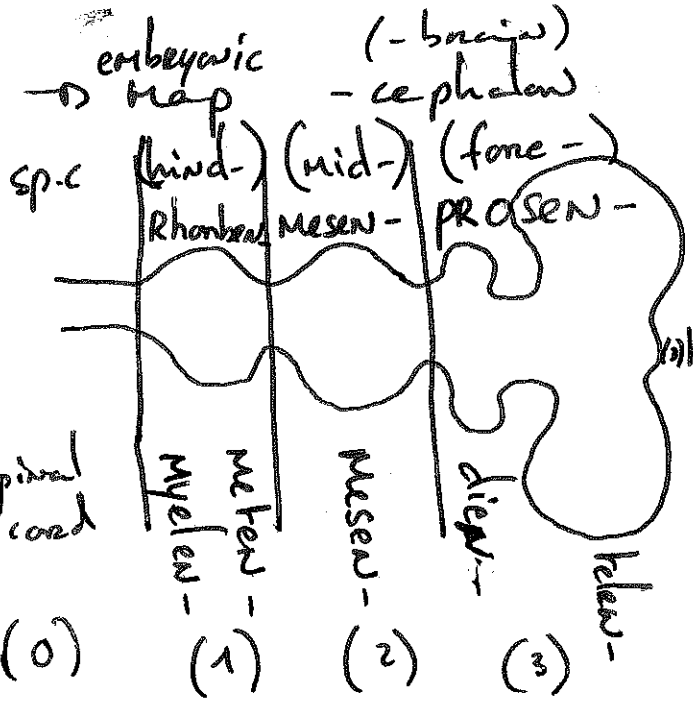
HORIZONTAL (xy - cut)

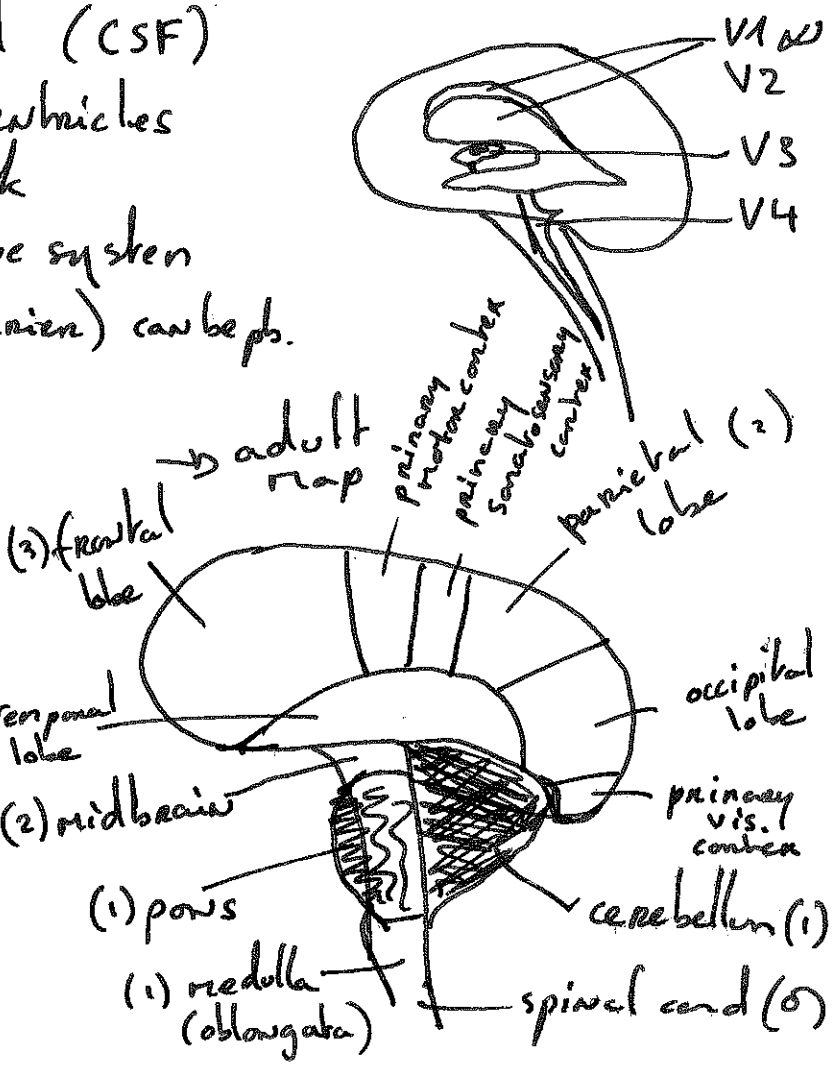


: CNS

→ encased in bone: skull (brain) + spinal column (sp. cord)

. cerebrospinal fluid (CSF)
  → contained in ventricles
  → protect from shock
  → separate from immune system (blood-brain barrier) can be pb.



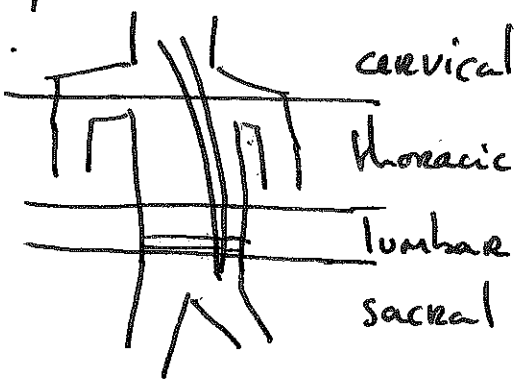


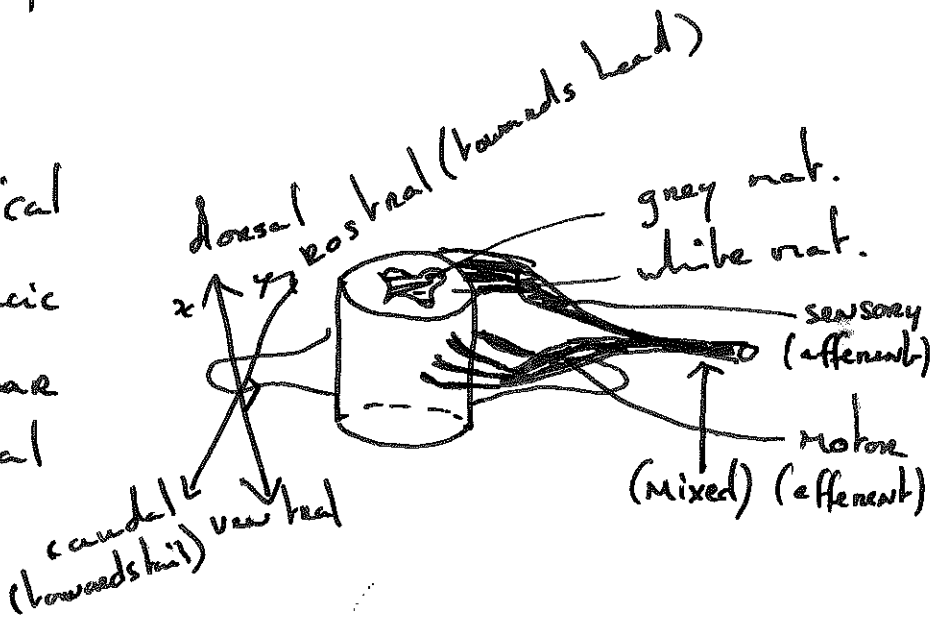
Brainstem = (medulla, pons, midbrain)

(3) forebrain
- telen- cerebrum
  - cerebral cortex (neocortex = isocortex, allocortex)
  - subcortical sites
    - Basal Ganglia
    - Limbic system
      - amygdala
      - hippocampus
      - cingulate cort.
      - anterior thalamus
      - parahippoc. gyrus (entorhinal cortex)
- dien-
  - thalamus
  - hypothalamus
  - pineal gland
  - ...

Major Structures of CNS

→ Spinal Cord





→ Medulla (see side-note) also where most nerves decussate (Lhem → Rbody, Rhem → Lbody)

Side-note: NERVES — cranial (innervate head) — nerve 0 (pheromones), nerves 1-12
spinal (—— body) — many

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continua of side-note:

- CN
  - CN in forebrain
    - CN in telencephalon (cerebrum) — (CN 0 Terminal), CN I Olfactory
    - CN in diencephalon (thalamus) — CN II Optic
  - CN in brainstem
    - midbrain — CN III Oculomotor
    - pons — CN IV Trochlear, CN V Trigeminal, CN VI Abducens, CN VII Facial, CN VIII Vestibulocochlear
    - medulla — CN IX Glossopharyngeal, CN X Vagus, (CN XI Accessory), CN XII Hypoglossal

→ Not cranial, mostly spinal (the cranial part fuses w/ Vagus)

→ Cerebellum
fluidity, meta-patterning

→ Pons
loca° of superior olive: vestibulocochlear (audio/balance)

→ Midbrain
dorsal: tectum — superior colliculus (visual) (saccadic)
ventral: tegmentum — inferior colliculus (visual) (audio)

vital / basic

→ Hypothalamus
· fight or flight, diurnal / nocturnal
· homeostasis → signals hunger, temperature, sleep...
· hormonal

→ Thalamus
· Relay centre for almost all sensory / motor info

→ Basal Ganglia
· motor ctrl
BG — striatum — caudate nucleus
striatum — putamen
BG — globus pallidus — substantia nigra
globus pallidus — nucleus accumbens
BG — subthalamic nucleus

→ Limbic System
· involved in olfac°, memories

→ Cerebral Cortex
· 2 cerebral hemispheres
· 3 major fissures
1. separate hemis (longitudinal cerebral fissure)
2. separate frontal lobe (central sulcus / Rolandic / lateral sulcus)
3. — temporal lobe (lateral sulcus)

sagit. CORON. horiz.. F P O T

(bump) gyrus (convolu° pack more neurons)
sulcus (valley)
longitudinal fissure
Loifrey bio: fissure

- Neuroimaging

→ Structural

- PostMortem – cadaveric brains! brainzz... mmm.
- CAT - Computerized Axial Tomography: X-ray info that (aka CT) can segregate CSF, bone...
- MRI - Magnetic Resonance Imaging:
  uses 3 magnetic fields:
  - static field: align protons (in Hydrogen) [1.5T-4T] (tesla)
  - pulse sequence: oscillating field causing protons to disalign
  - gradient field: varies the intensity to provide remaining spatial info –

  → receiver coil records the relaxation time of protons (how long to realign)

- DTI - Diffusion Tensor Imaging:
  - Water diffusion is isotropic (in CSF) but anisotropic in the brain, DTI measures ~~both~~ water diffusion tensor info by (1) pulse to get initial position of protons then (2) pulse to get where they have moved. ~~Such~~ such constructed tracts (tractography) are based on a number of assump°.

→ Functional + Metabolic

- PET - Positron Emission Tomography: radioactive
  - substance introduced in blood stream, when becomes stable, positron is emitted that will collide with e^- to

emit 2 photons in opposite directions, which are then measured and through 'backwards extrapolation' can determine original location of radioact. particle. [PET scans can only be performed 2-5 times a year]

. Useful because can follow exact molecules (provided radioactive version can be made) _ Also because gives 'absolute' measure of brain metabolism: increased neural activity is associated with changes in blood flow, oxygen use and glucose metabolism; all can be measured with PET (it provides 'absolute' measure of regional cerebral blood flow: rCBF)

. SPECT - Single Photon Emission Computed Tomography: same as PET but very localized and poor resolution, but cheaper.

. fMRI - functional MRI:

. Better spatial resolution than PET, also less time (2secs vs 90secs for ^{15}O bc of its half-life), but less temporal resolution than EEG.

. Common methodology: BOLD (Blood Oxygenation Level Dependent) measures 'relative' concentration of oxygenated/deoxygenated blood (oxyhemoglobin / deoxy) — of substraction method

→ Functional + Electromagnetic → best temporal resolu° (~ ms)

. Single-Cell Recording

. Intracellular microelectrode is placed in soma, ref electrode elsewhere, signal is amplified before recording.

. Allows to check whether cell responds to multimodal signals etc.

. EEG - Electroencephalography:

δ: 0-4Hz
θ: 4-7Hz
α: 8-12Hz
β: 12-30Hz
γ: 30+Hz

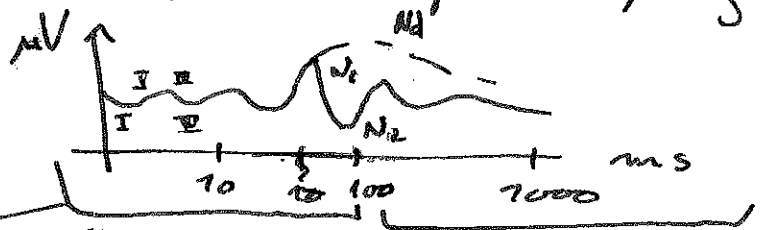
. Using 10/20 system, each electrode (lead) records electrical fields of similarly aligned dendrites' postsynaptic dipoles i.e an electrical potential [provides continuous measures of brain activity]

. Ref electrode is placed usually behind the ear, but in case leads are on the scalp, can also place an electrode next to eye s.t. muscle contract (eye move) can be subtracted

. ERP - Event-Related Potentials:

. In continuous EEG, ~~record~~ present stimulus and record for a bit, then repeat (~100 times) and average.

. Result is a waveform of components, e.g.



early components (≲100 ms) are 'exogenous' (correspond to sensory processing of stimulus

later components are 'endogenous', how cog procs affect incoming info.

. MEG - Magnetoencephalography:

. Dipoles created within grps of neurons (v/sin. al. den.) induce a magnetic field (very weak ~fT) that can be measured with costly equip't in a screen room (aluminium foil to prevent interference from other magnetic fields like Earth, wires) MSR (mag. shield room)

Superconductions + SQUIDS

. Provides better info than EEG about source of signal, but cannot detect activity from dipoles oriented radial to brain surface

. ERF - Event Related Field: akin to ERP for MEG

→ Functional + Optical

. DOI - Diffuse Optical Imaging: ← IR

. measures dispersion/scattering, absorp°... of light when it traverses brain tissue. {can segregate well.
fast signal (swelling of neurons/glia)
slow signal (blood deoxy)

. EROS - Event-Related Optical Signal:

. akin to ERP, ERF; uses fast signal for best (~milli) spatiotemporal res.

. cannot reach subcortical sites as light gets absorbed.

. Neurostimulation

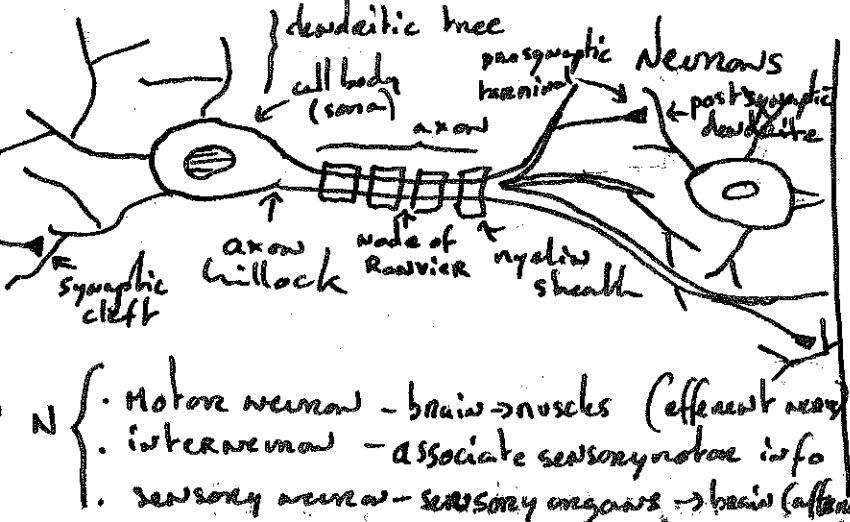
→ TMS - Transcranial Magnetic Stimulation

. single pulse TMS or repetitive TMS (rTMS) delivers a magnetic field that changes membrane polarity and induces 'scrambled' firing.

. invaluable in probing the brain and clinical applications

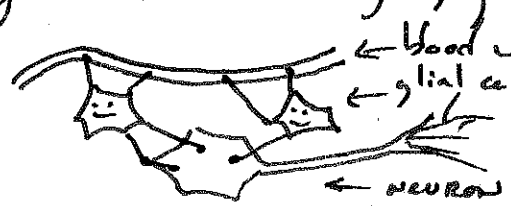
. Neural Communication

→ Brain Cells



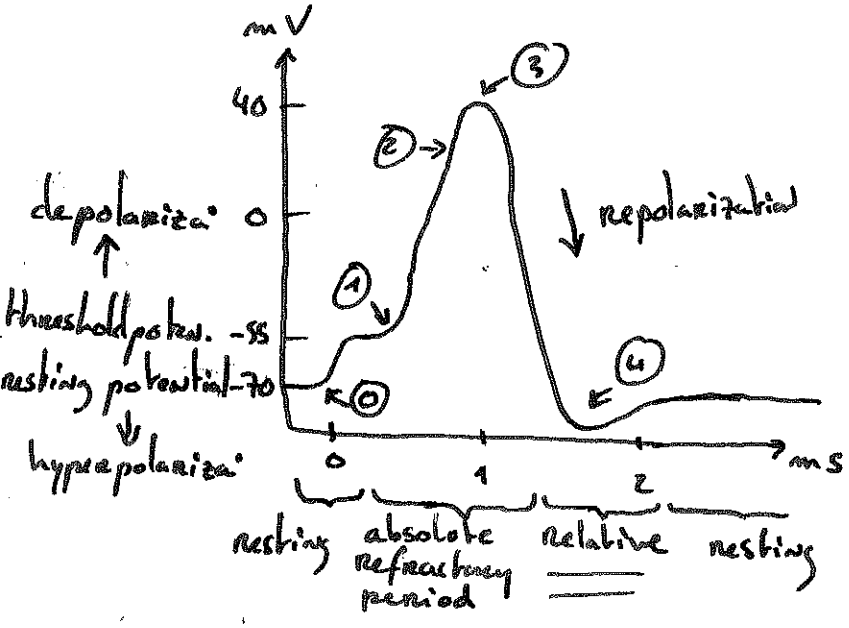
N { . Motor neuron - brain → muscles (efferent neuron)
. interneuron - associate sensory+motor info
. sensory neuron - sensory organs → brain (afferent)

glia (aka neuroglia, glial cells)

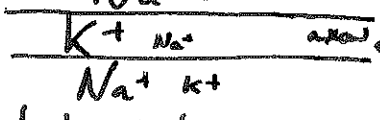


G { CNS { astrocytes: blood-brain barrier
oligodendrocytes: myelination (multi)
microglia: repair damaged & protect (immune)
PNS { Schwann cells: myelination (single)

Action Potential



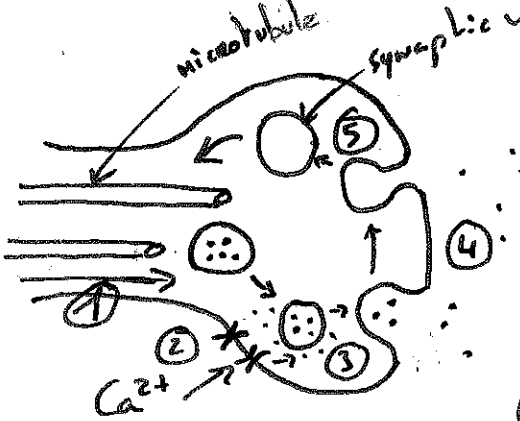
0. Depolarizing stimulus
1. Sodium channels open, Na^+ → axon
2. Potassium channels open, axon → K^+
3. Sodium channels close (axon → K^+)
4. Potassium channel close, sodium-potassium pump takes some resting concentration of ions is back.



- all-or-nothing principle
- Self-propagating
- Constant amplitude

1. Action Potential initiated (computed) at axon hillock
2. Propagates through axon to terminal buttons.
3. Synaptic vesicles release neurotransmitters into synaptic cleft from presynaptic side
4. Neurotransmitter fit into the postsynaptic membrane's (binding site) to invite an electrical sig.

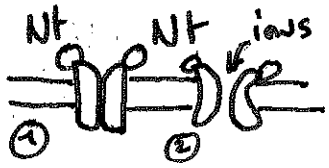
receptors



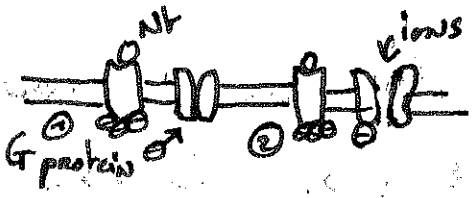
1. Action Potential reaches axon terminal
2. Calcium Channels open allowing Ca^{++} ions in
3. Ca^{2+} cause synaptic vesicles to fuse w/ axon membrane and release neurotransmitter
4. Neurotransmitters released in synaptic gap
5. Vesicles are recycled

Receptors:

- Ionotropic
  - direct
  - short life



- Metabotropic
  - indirect
  - longer lasting



Postsynaptic Potential

- weakens when traveling (graded)
- low amplitude (0.5-5 mV)
- can be excitory (EPSP) or inhibitory (IPSP)

Axon Hillock Computation

- Neuron has ~100-1000 other neurons synapsing with it
- All ESPS (reduces membrane polariza°) and ISPS (increases m.p.) are summed at hillock and if > -55mV ⇒ A.P.

ESPS/ISPS:

- greater effect if close to soma and if ESPS (or ISPS) are close together
- greater effect if ESPS happen at same time!

→ Neuronal firing

- Intensity of stimulus is coded in neurons firing rate (which is bounded at 200Hz because the ion channels need to be reset).
- During the absolute refractory period (arf) no other AP can be initiated
- During the relative ———— (rrf) it requires much more stimulation to initiate other AP.
- To avoid a stimulus that has ended to still have effect, Nts must be cleared from syn. cleft:
  - → Reuptake: Nts are grabbed quickly back by presyn. membrane
  - → enzymatic deactivation: enzyme deactivates Nt.
    - Mainly for acetylcholine that is broken down to choline and acetate by acetylcholinesterase (can break 500 molecules per second!)
  - → glia degradation: astrocyte absorbs excess Nts and breaks
  - → autoreceptors: receptors on presyn. membrane acting as 'negative feedback' (mediates e.g. tolerance to drugs)
  - → diffusion: Nt 'floats away'.

→ Neurotransmitters

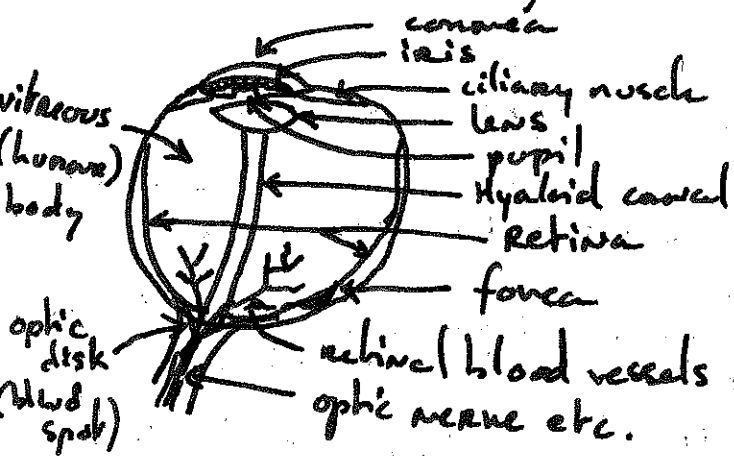
Nt {
- Amino Acids: glutamate, aspartate, γ-aminobutyric acid (GABA), glycine
- Monamines (& other biogenic amines): adrenaline (epinephrine), histamine, serotonine, dopamine (DA), norepinephrine/Noradrenaline (NA/NE)...
- Peptides: somatostatin, substance P, opioid peptides...
- Others: acetylcholine (ACh), adenosine, anandamide, nitric oxyde...

→ Can be excitory or inhibitory depending on receptors they bind to.
e.g. GABA is inhibitory in general but excitory during brain development

→ Myelination

- Insulation, speeds up AP propagation (nodes of Ranvier make sure of 1st amplitude)
- Fiber tracts: myelinated axons going in same direction (e.g. corpus callosum)
- Myelin = fat = white ⇒ white matter heavily myelinated, gray matter not (ie. neurons typically synapse quickly in cerebral cortex) → c.c. = g.m.

Perception & Object Recognition

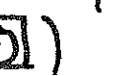


- Photo receptors
  - → Rods:
    - 1 pigment: rhodopsin (sensitive to low luminosity) → rod system does not function in broad daylight
    - distributed more in the periphery (away from fovea)
    - many rods feed into one such ganglion cell (low levels of light can be Σ, tradeoff precision)
  - → cones:
    - 3 pigments, 1 per each type of cone (S - short wave length: blue, M - medium w.l.: green, L - long w.l.: red)
    - densely packed around fovea
    - few cones feed into each ganglion cell (↑precision, tradeoff: ↓sensitivity to low luminosity)
    - colour vision is delicate patterns of S, M, L.

- Ganglion Cells & Receptive Fields
  - Many types, ~~80% are~~ main types (~80%) are P (midget) and M (parasol)
    - → M (parasol) ganglion cells:
      - large RF (receptive field) → coverage of peripheral retina
      - coarse patterns & rapid motion
      - stimulation: transient
    - → P (midget) ——
      - small RF → coverage of fovea
      - colour & details
      - stimulation: sustained

Ganglion (photoreceptive RF is more localised)

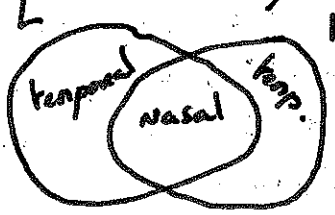
- Receptive field: local area of ganglion cells that receive input from light shining from a specific location of visual space.
  centre-surround structure ⊙ ⇒ ⫴, ⫴ ⇒ ⊙ ⇒ ⫴

- Vision redux: ↓ enters eye at cornea, gets refracted by bicarex lens to be focused (upside-down) on the retina. Rods and cones send their signals into intermediary cells (horizontal, bipolar) that synapse onto ganglion RF. These send their axons towards the optic disk where they get bundled into the optic nerve. Notice that - lots of (parallel) preprocessing of visual info has already happened at this point. (To find blind spot: )

• Pathways from retina to brain

—▷ Tectopulvinar pathway

• Mostly M ganglion input => { quick reac° (to motion), poor detail (coarse)
{ more sensitive to novel objects in temporal hemifield than nasal.



Visual field:

⇓
superior colliculus is more sensitive to temporal hemifields.

⇑
CN III, IV { • Sends output to superior colliculus in tectum, which is also a relay centre for auditory info (inferior col.). Adaptive interac° make audiovisual synced stimuli to be more relevant.

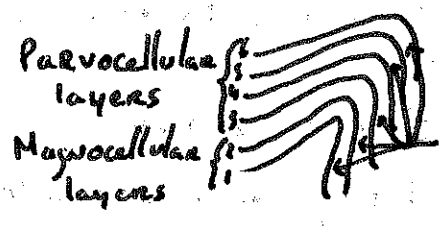
(CN II) { • Sends output upstream to pulvinar nuclei (thalamus) and cortex
CN VI { for eye/head movt. also extends downstream to brainstem.

—▷ Geniculostriate pathway

• 90% of CN II fibers project on it. Responsible for obj-recog, colour, detail
• ~~Both lefts~~ Axons in the geniculostriate portion of both optic nerves (of L-eye and R-eye) synapse onto the Lateral Geniculate Nucleus (LGN), then visual info is sent to striate cortex (aka prim. visual. cortex)
• Axons from GRFs of L side of retina of both eyes are combined at optic chiasm to form L-optic tract that is sent to L-LGN. (same for R-LGN)
vs nerve
• Thus L-LGN contains visual info from R-visual field. (L-vf. → R-LGN)

—▷ Lateral Geniculate Nucleus

'knee' shaped



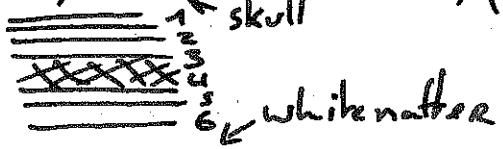
M-layers: input from M retinal ganglion cells
l1: ipsilateral eye, l2: contralateral eye
P-layers: ——— P ———
l4, l6: ipsi. eye, l3, l5: contra. eye
K-layers: ——— bistratified ganglion c. and from superior colliculus.

• Layers are retinotopic (same spatial org as retina)
• Top-down processing from cortex
• Relay point, visual info is then sent to striate cortex.

→ Striate Cortex

. A.k.a. Prim. Vis. Cortex, V1, Brodmann area 17, (striate → stripes)

. LGN → layer 4 of V1.



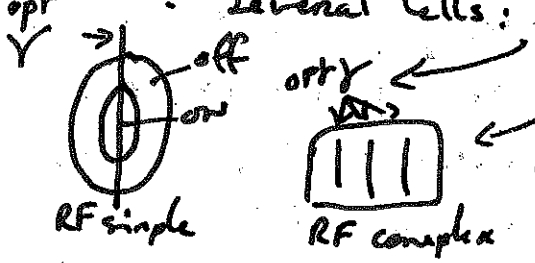
. cortical magnific° factor (mm of cort. surface / angle of visual space)
grows for cells getting input from RGCs close to fovea (100 to 1)

. Map is still retinotopic (all? which one? His book really sucks, but 10 pages later, yes, all maps ⇒ less than the prof, I mean DR ...)

. Several Cells: . simple: RF is bar-shaped, ≠ orientn°

. complex: ——————, moving lines

. hyper-complex: ——————, line sizes are captured



. Hypercolumns

→ Within hypercol, there are 'cylinder-like' grps of cells involved in colour processing called blobs.

→ Magno & Parvo inputs are segregated ⇒ distinct laminar projec°

middle temporo-occipital

LGN	V1	V2	
Magno	→ 4Cα → 4B (diffuse)	→ Thick	→ (motion, stereo) MT (V5)
Parvo	→ 4Cβ → 2/3 interpatch	→ Pale	→ (form) V4
	→ 2/3 patch	→ Thin	→ (colour) V4) isoluminant colour

. Binocular disparity

→ images on L & R retinas are not exactly the same (when looking closer, ≠ ↑) for depth percep° purposes. binocular integration starts in the striate cortex.

. Contextual modulation (top-down & nearby)

→ salience of stimulus compared to surrounding, background/foreground segreg.

→ Blindsight.

- No conscious experience of sight, but some visual (hidden) abilities.
- Plethora of Blindsight types. ~~some sight use~~
- Cortical Blindness : damage to V1. Hemanopia : one-sided cortical blindness
  - Spared tectopulvinar path
  - LGN project to other areas of occipital lobe (V2-6)
  - Some cortex has been spared.

→ Extrastriate cortices

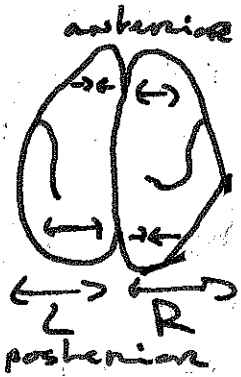
- Retinotopia preserved in V2, V3, V4. Each gets divided in a dorsal half (responsible for lower visual field) and ventral half — (No, book is so bad! only V2, V3)
  - (so usually only one vis-field loses colour)
- V4 has been identified with processing of some colour info. For instance, some cells display "colour constancy" (shades of red are interpreted as red, regardless of (orientation)).
  - (achromatopsia to damage to V4, very rare that it happens on both sides)
- Much controversy, but generally colour processing happens in ventral-anterior parts of V4 (V4α) as well as some in V4 proper
- Ventral stream (what pathway) vs Dorsal stream (where/(how) path)

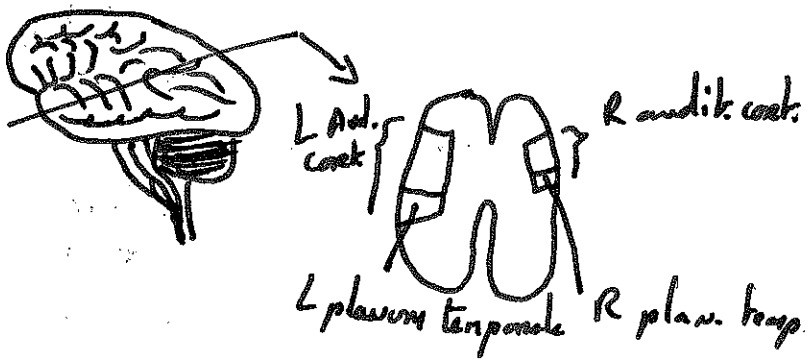
→ Ventral visual-processing stream (obj. recognition)

- Occipital, occipitotemporal, temporal regions
- Along stream : obj complexity ↗ and RF ↗ (also, almost always include foveal RFs)
- Loss of a lot of spatial info (dorsal stream takes care) compared to V1
- Visual agnosia : modality specific; inability to recognize objects (vis.)
  - apperceptive Vis. Ag. : difficulty in combining visual data into a 'percept' (object, face, ...) — (usually diffuse damage across occip. regions)
  - associative — , — in associating percepts with previous knowledge, although percepts themselves are not that great. — (— bilateral of occipitotemporal sites)
- Prosopagnosia : face agnosia
  - Sometimes developmental (vs lesion)
  - Implicit recognition (unconscious) is probably still happening a bit.

Hemispheric Specialization

→ Anatomical





→ Historical

1860s - Paul Broca : 'Tan' guy → study of Broca's area (L hem)
1860s - cerebral dominance : language ↑ => L hem dominates R hem
1970s - split brain research (Sperry) (limits : split brain pop has seizure + VIQ bias)
- Wada technique : inject barbiturate in carotide → 95% of Right handed have L hem dom. for language

→ Taxonomy redux

Psychology → Cognitive Neuroscience
Psychology → Cognitive psychology
Neuroscience → Neuropsychology (Broca - Wernicke) (damage methods)
(cognitive neuropsychology (cog neuropsychiatry etc.) clinical + field methods)

(unrelated note : patient H.M. (grandad retrograde + anterograde) died at age 82 (2008), so his name is now available : Henry Molaison)

(Neurology : neural descendens (medical) → Neurobiology : biological neuro)

Also have → Eco → Behavioral Eco
Psy → CogPsy → CogNeuro → NeuroEconomics
Neuro → CogNeuro

→ Non lesion studies

modalities
- Divided Visual Field technique : L vs R vis. field
- Dichaptic presentation : feel simultaneously 2 items in each hand
- Dichotic ——— : different info presented simultaneously to each ear

→ Models :
- → direct access theory : each hem receives info and processes it, hem less suited to a task will produce poorer results
- → callosal relay model : info goes to appropriate (dominant for task) hem, info gets degraded during test (corpus callosum)
- → activating-orienting model : attentional bias results from fact ∃ dominant hem. → contralateral side is more "attended" to (=> ↑ signal quality)

→ perceptual asymmetries

~~In right handed individual with~~ In general:

- Lhem: . dominant for language
  - . Vis: word recognition
  - . AUD: (~~dichotic words → favour R ear~~) word recognition
  - . TAC: recognize letters on palm
- Rhem: . dominant for spatial reasoning
  - . Vis: face recognition
  - . AUD: nonword recognition ('dichotic quality')
  - . TAC: recognize nonlinguistic shapes (and fit them)