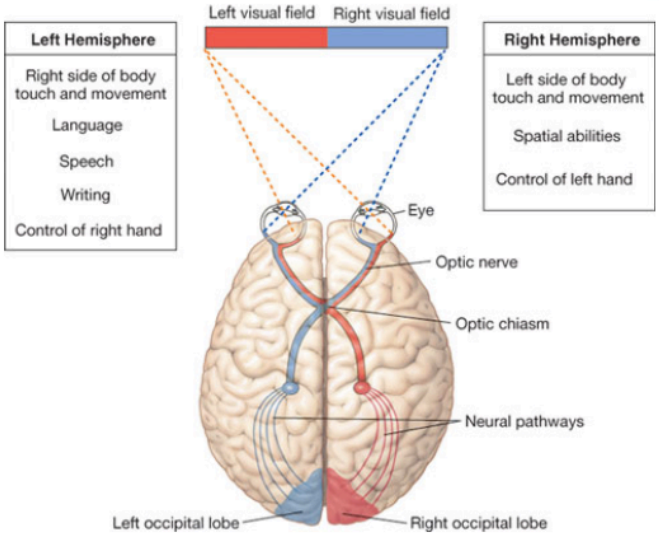
Week 2 – Visual processing (higher centres)

- Signals from the retina travel through the optic nerve → lateral geniculate nucleus (LGN) → primary visual receiving area in the occipital lobe (striate cortex) → through two pathways to the temporal and parietal lobe → arriving at the frontal lobe

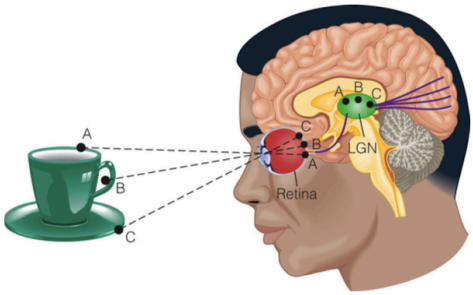


Processing in the LGN

- LGN cells have centre-surround receptive fields
- Major function of LGN is to <u>regulate</u> neural information from the retina to the visual cortex
- Signals are received from the retina, the cortex, the brain stem, and the thalamus and organised by the eye, receptor type and type of environmental info

Organisation of LGN

- Six layers which each receives signals from one eye
- Ipsilateral eye: layers 2,3,5; contralateral eye: 1,4,6
- Each eye sends signals to both LGNs and the info for each eye is kept separated
- **Retinotopic map:** each place on the retina corresponds to a place on the LGN
- Cortex shows retinotopic map→ Receptive fields on the retina that overlap, also overlap in the cortex



Neurons in the striate cortex

- **Simple cortical cells:** side-by-side receptive fields; respond best to bar of light oriented along the length of the receptive field
- **Orientation tuning curves:** shows response of simple cortical cell for orientations of stimuli
- **Complex cells:** respond to bars of light of a particular orientation (like simple cells) but also respond to movement of bars of light in specific direction (unlike simple cells)
- **End stopped cells:** respond to moving lines of specific length, moving corners or angles; doesn't respond to stimuli that are too long

Feature detectors

- Neurons that fire to specific features of a stimulus; pathway away from retina shows neurons that fire to more complex stimuli
- Simple cortical cell; complex cortical cell; end-stopped cortical cells are all feature detectors

Type of Cell	**Characteristics of receptive field**
Optic nerve fibre (ganglion cell)	Centre-surround receptive field Responds best to small spots, but will also respond to other stimuli
Lateral geniculate	Centre-surround receptive fields very similar to the receptive field of a ganglion cell
Simple cortical	Excitatory and inhibitory areas arranged side by side. Responds best to bars of a particular orientation
Complex cortical	Responds best to movement of a correctly oriented bar across the receptive field. Many cells respond best to a particular direction of movement
End-stopped cortical	Responds to corners, angles, or bars of a particular length moving in a particular direction

Selective adaption

- Neurons tuned to specific stimuli fatigue when exposure is long ; fatigue or adaption to stimulus causes: neural firing rate to decrease, neuron to fire less when stimulus immediately presented again
- Selective means that only those neurons that respond to the specific stimulus adapt
- Method for selective adaption: measure sensitivity to range of one stimulus characteristic; adapt to that characteristic by extended exposure; re-measure the sensitivity to range of the stimulus characteristic (see how adaption has changed perception of the stimuli)
- Stimulus characteristics for selective adaption: gratings are used as stimuli: made of alternating light and dark bars, angle relative to vertical can be changed to test for sensitivity to orientation; difference in intensity can be changed to test for sensitivity to contrast
- Method for contract sensitivity: decreasing intensity of grating until person can just see it; low threshold = high contrast sensitivity

Selective rearing experiments

- Animals are reared in environments that contain only certain types of stimuli; neurons that respond to these stimuli will become more predominant due to neural plasticity
- Blakemore and Cooper (1970) reared kittens in tubes with either horizontal or vertical lines; both behavioural and neural responses showed the development of neurons for the environmental stimuli and the loss of others

Organisation of the visual cortex

- **Location columns:** receptive fields at the same location on the retina are within a column
- **Orientation columns:** neurons within columns fire maximally to the same orientation of stimuli; adjacent columns change preference in an orderly fashion
- **Ocular dominance columns:** neurons in the cortex respond preferentially to one eye; neurons with the same preference are organised into columns
- **Hypercolumns:** contain a single location column; left and right dominance columns; a complete set of orientation columns (0 – 180 degrees); this is called the 'ice-cube' model

Functional magnetic resonance imagine (fMRI)

- Haemoglobin carries oxygen and contains a ferrous molecule that is magnetic
- Brain activity takes up oxygen, which makes the haemoglobin more magnetic
- fMRI determines activity of areas of the brain by detecting changes in magnetic response of haemoglobin

Lesioning or albation experiments

- An animal is trained to indicate perceptual capacities before a part of the brain is removed/ destroyed, then the animal is retrained to determine which perceptual abilities remain. The results reveal which portions of the brain are responsible for specific behaviours

What and where pathways (Ungerleider and Mishkin experiment)

- Removal of temporal lobe tissue resulted in problems with object discrimination – what pathway (**ventral pathway)**
- Removal of parietal lobe tissue resulted in problems with landmark discrimination – where pathway (**dorsal pathway**)
- Both pathways:
  - Originate in retina and continue through two types of ganglion cells in the LGN
  - Have some interconnections
  - Receive feedback from higher brain areas
- Where pathway may actually be 'how' pathway → dorsal stream shows function for both location ***and*** action (e.g. patient D.F.)