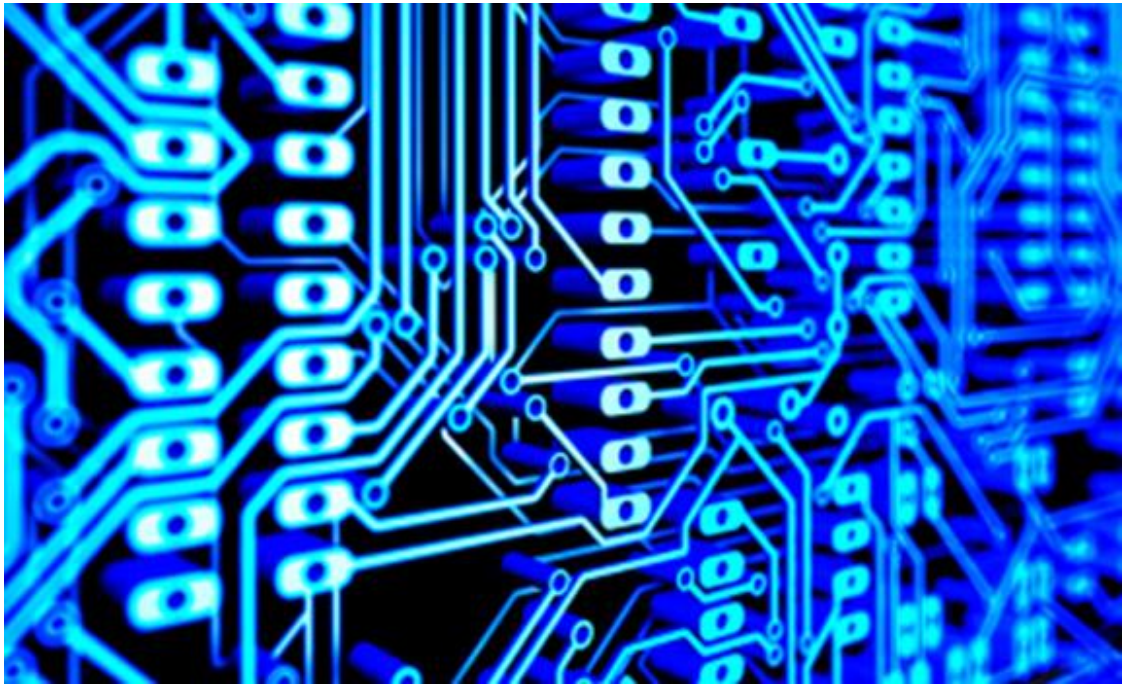
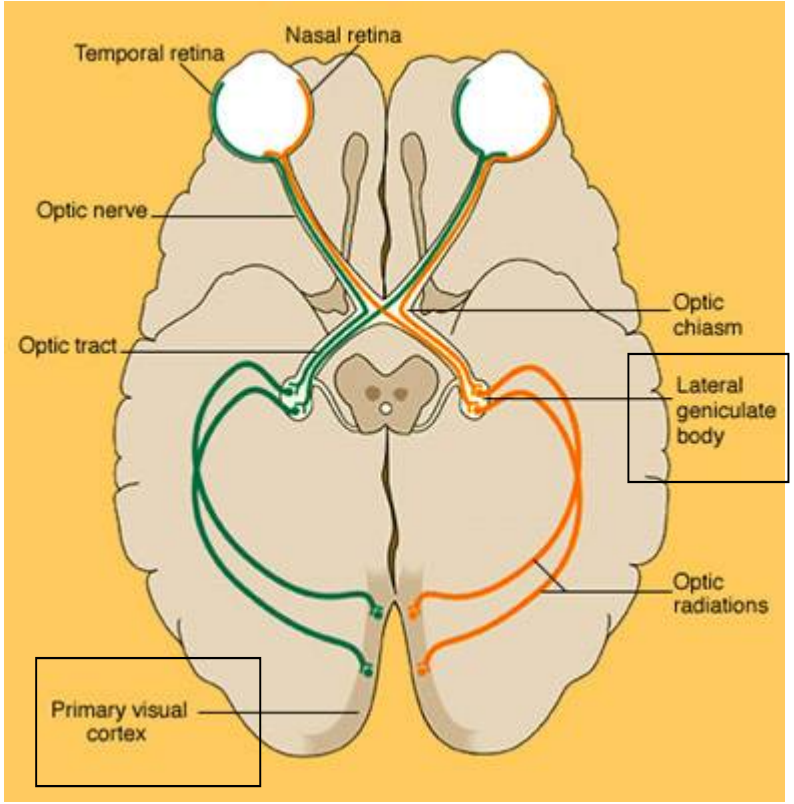
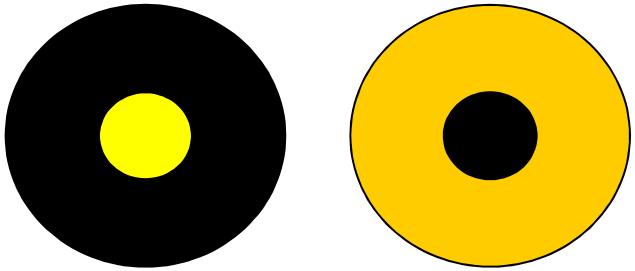
Onto the Brain !





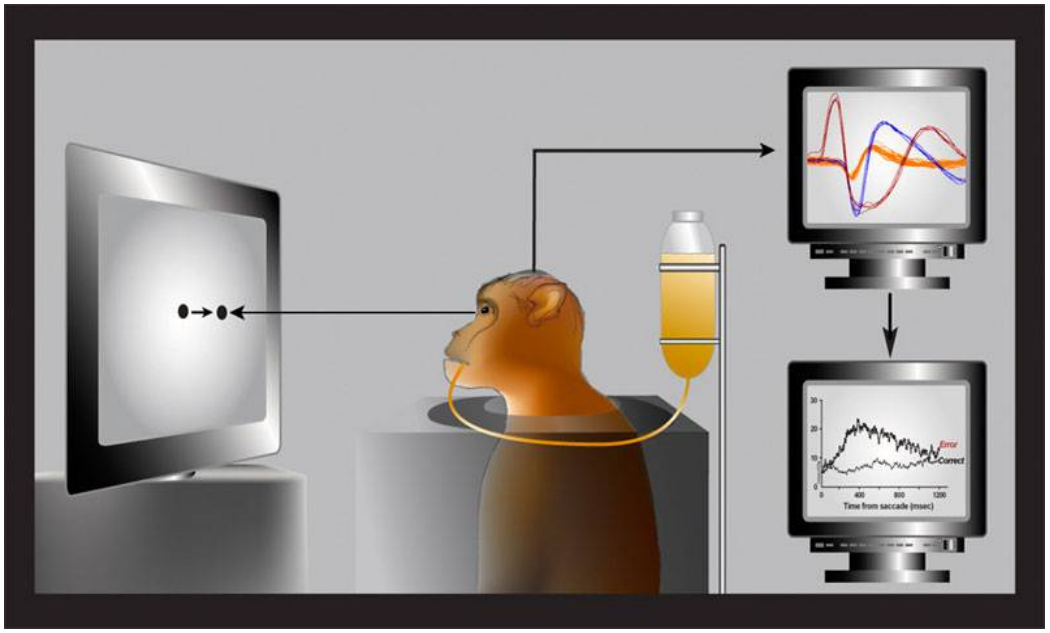
Neurons go from the retina to the lateral geniculate nucleus (LGN) and then onto the visual cortex.

Receptive fields of the lateral geniculate nucleus



As the receptive fields of neurons in the LGN are not very much altered, people think there is not much processing of the sensory input in the lateral geniculate nucleus.

Receptive fields of the cortex



Electrophysiological recordings in the cortex

Area V1 of the cortex

Just as for the retinal neurons, receptive fields of many of the neurons in the area V1 have antagonistic sections in their receptive fields.

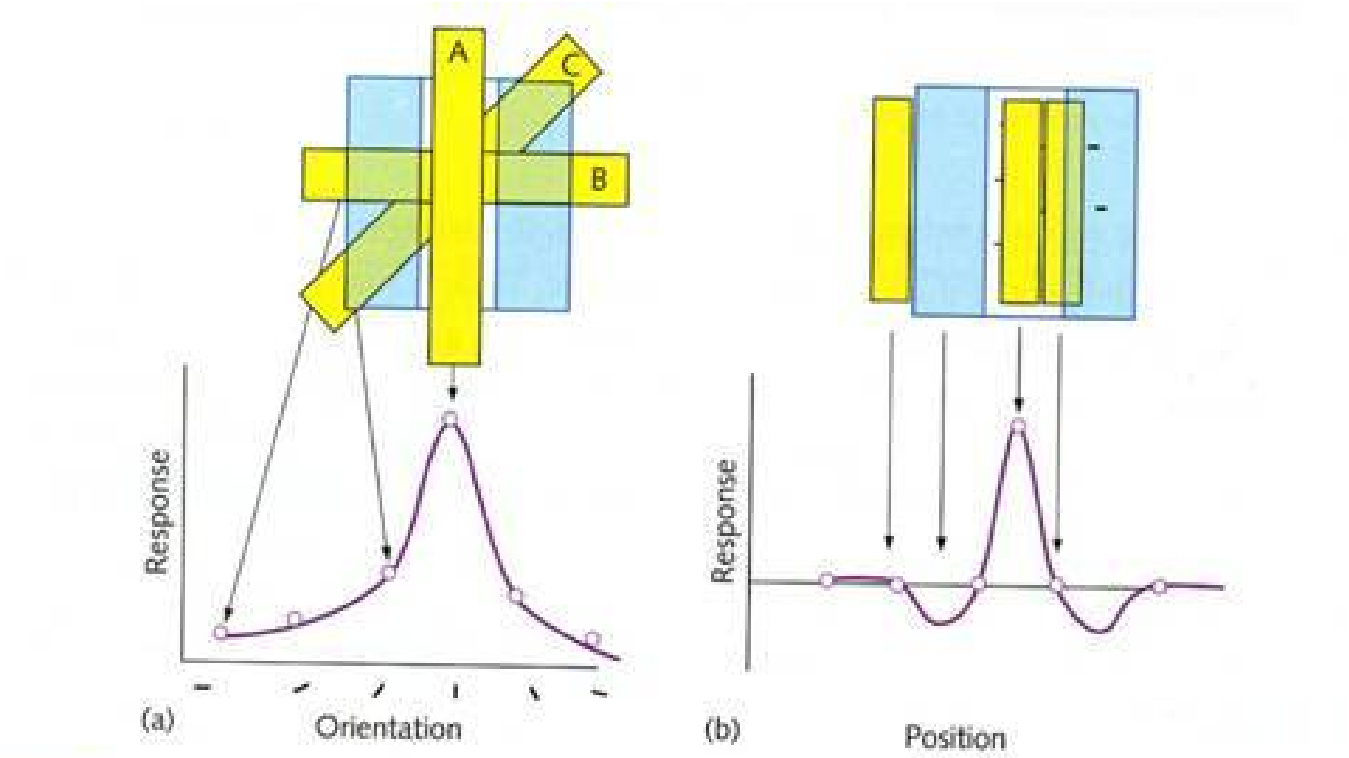


Fig. 3.9. The elongated receptive field of a V1 cell shows a strong preference for lines of one orientation over others. Here the cell responds best to vertical lines and bars.

The receptive fields of the V1 neurons are created by the convergence of axons/input from the retina

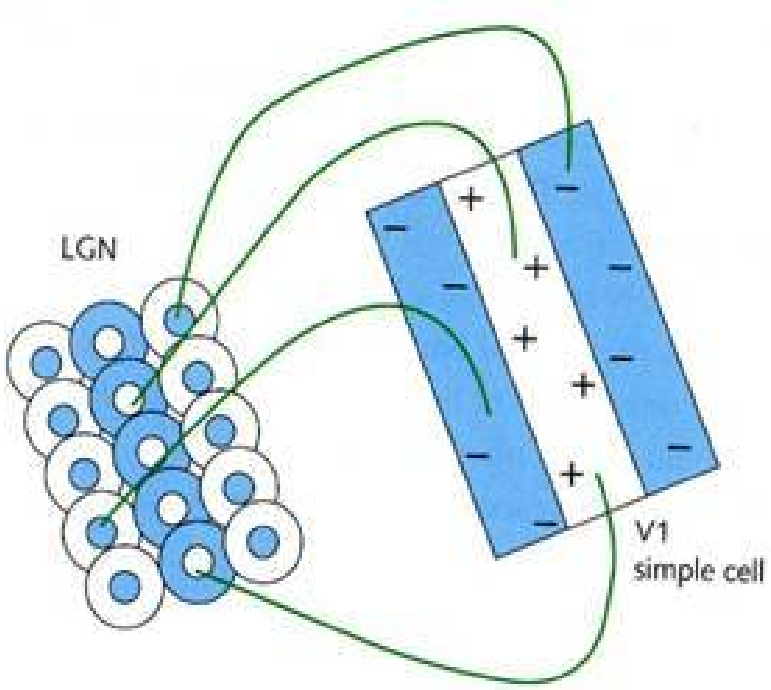


Fig. 3.11. Making a V1 receptive field from LGN inputs. The elongated bar detector has an inhibitory central stripe flanked by two excitatory regions. It will respond best to a dark bar, tilted to the left, on a bright background.

These cortical neurons are called simple cells.

Bar detectors and edge detectors of cortical area V1

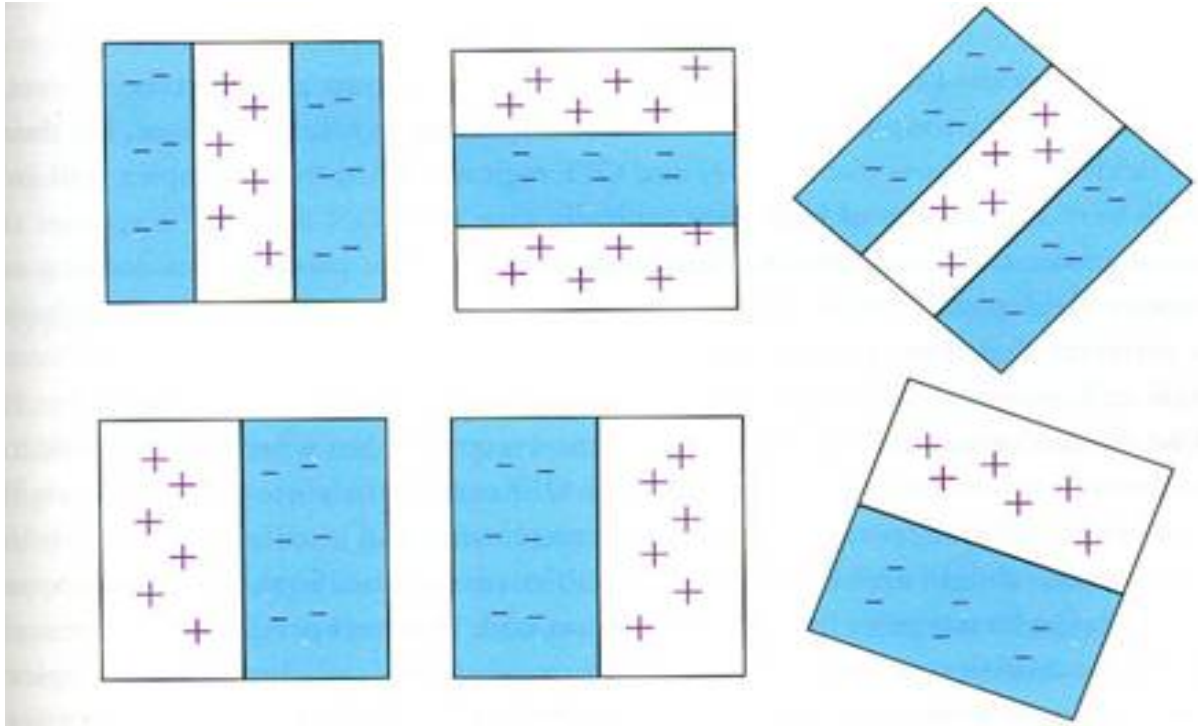
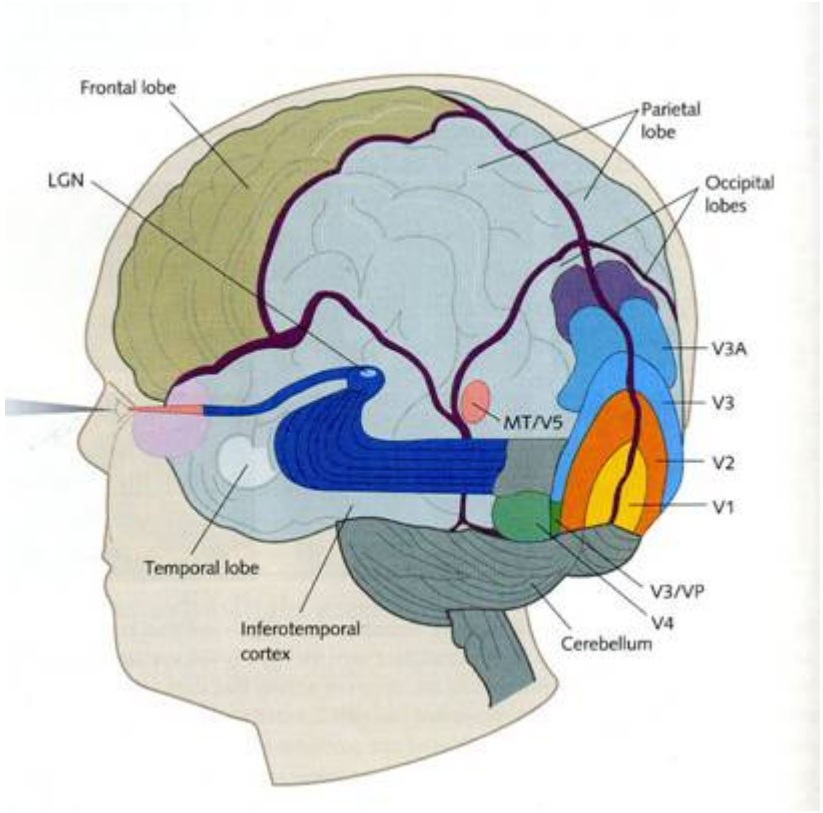
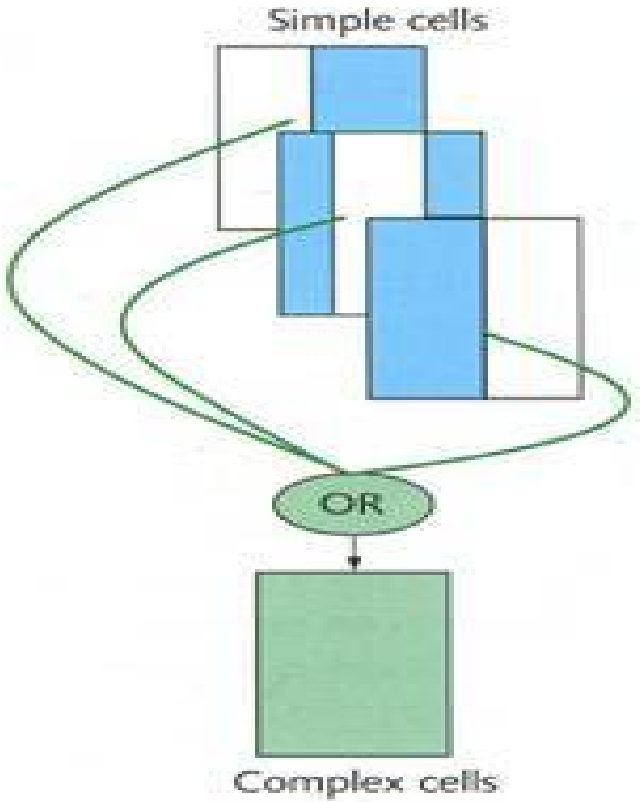


Fig. 3.10. Various V1 receptive fields; some can be regarded as bar detectors and others as edge detectors. Both sorts can have different orientation preferences.

Higher area in the visual cortex



The receptive field of complex visual neurons is thought to be built by the convergence of axons/input from several simple neurons



Hypercomplex or end stopped neurons

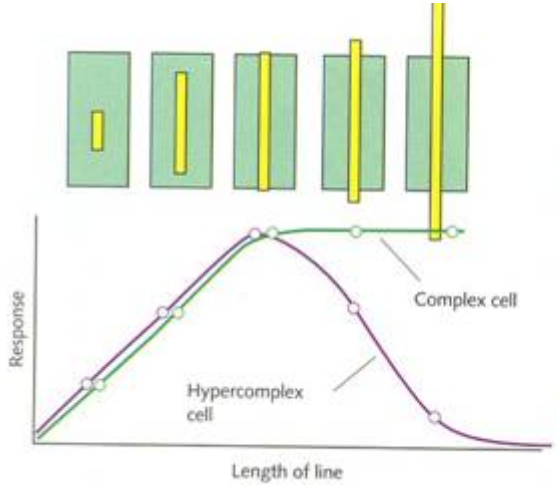


Fig. 3.13. Hypercomplex (or end-stopped) cells prefer stimuli of a certain length as well as orientation.

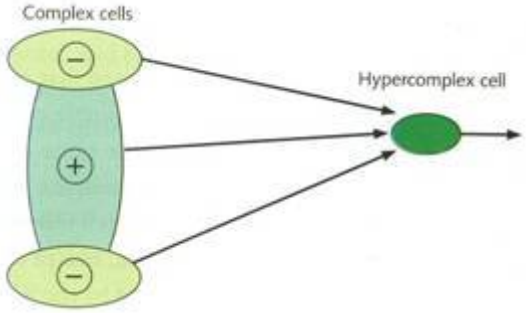
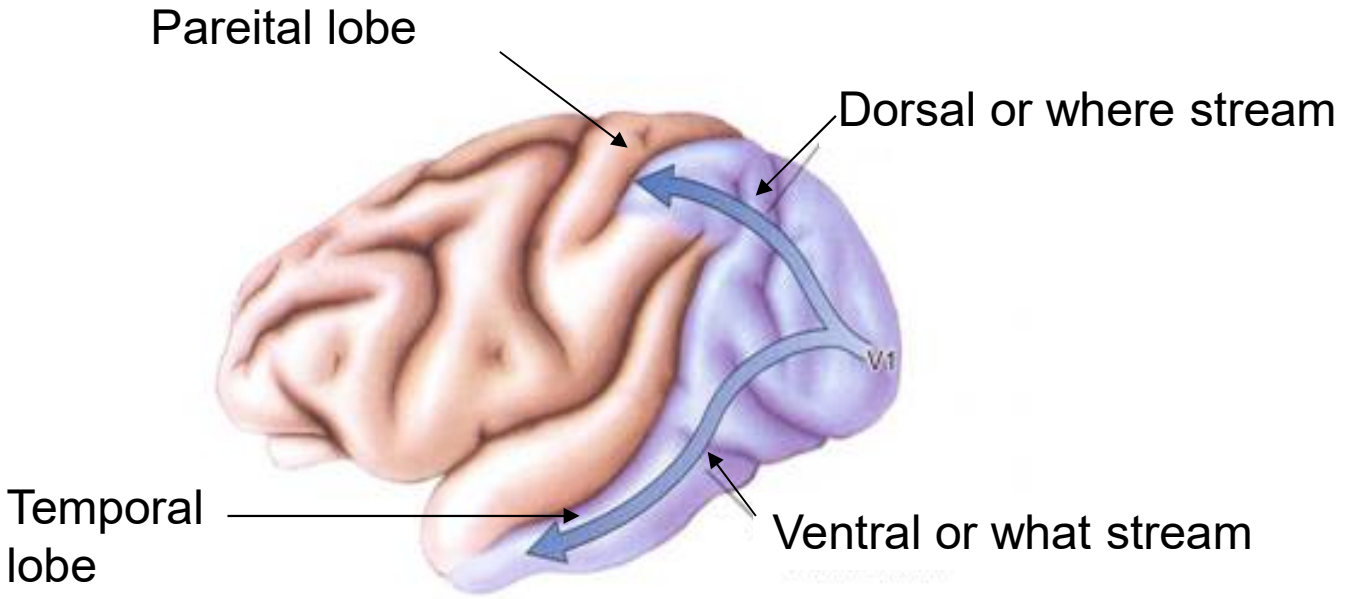


Fig. 3.14. Making a hypercomplex cell from complex cells.

What and Where of Vision

The what and the where of vision appears to be processed in a parallel manner and there appears to be some dissociation between these two tasks.



The Dorsal or Where stream

It is associated with spatial awareness and the guidance of actions. Direction selective neurons can be found in this area.

Direction selective neurons in the dorsal stream

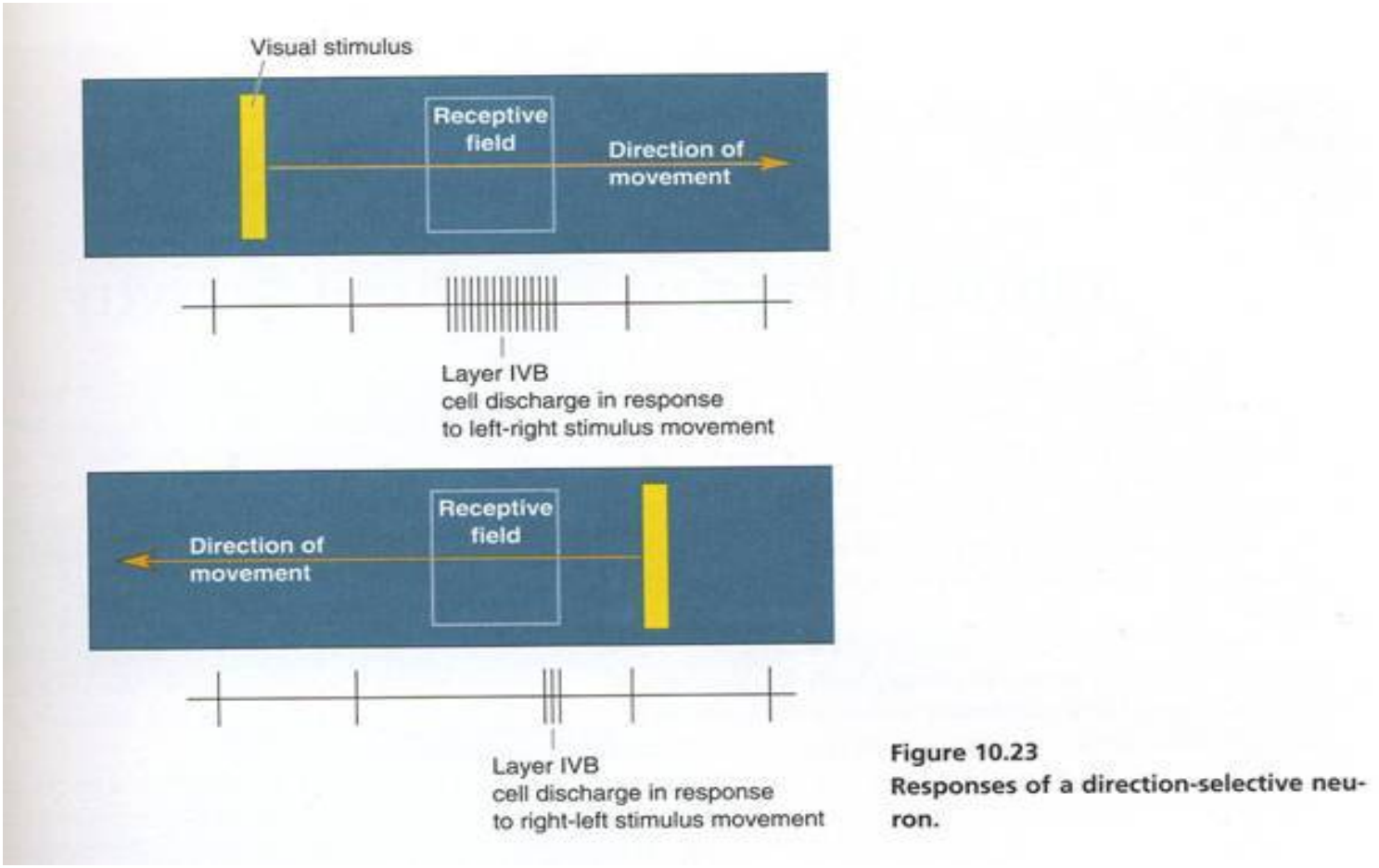
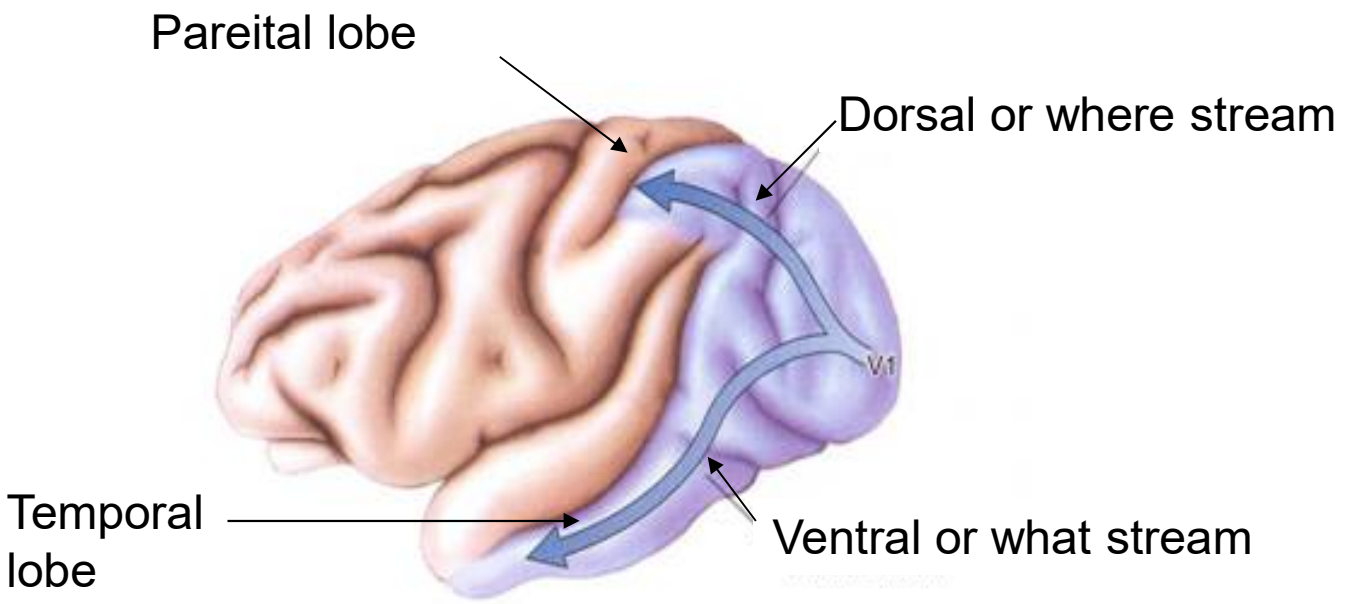


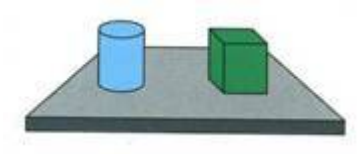
Figure 10.23
Responses of a direction-selective neuron.



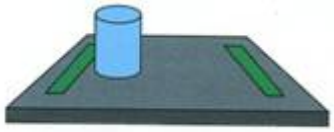
The Ventral or What stream

It is associated with object recognition.

There is some dissociation between these two tasks in the brain

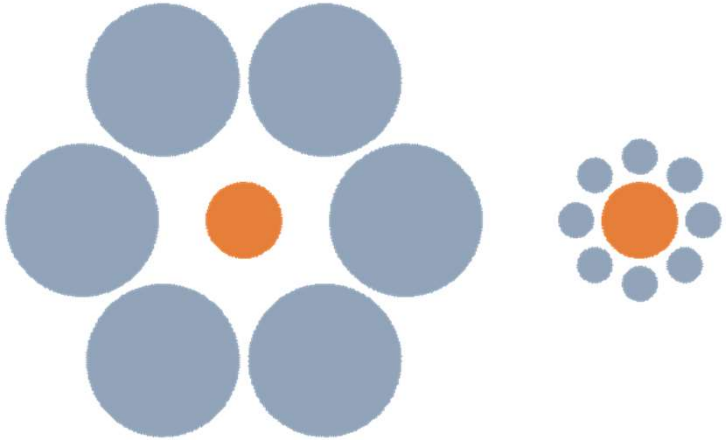


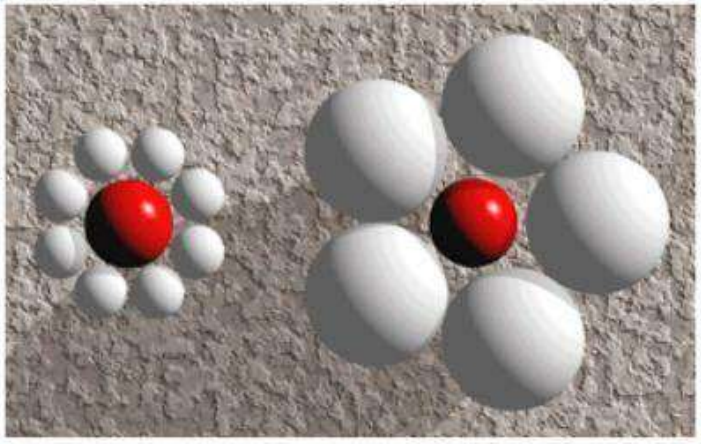
A monkey with lesions in the temporal cortex is unable to learn that the food is always under the same object.



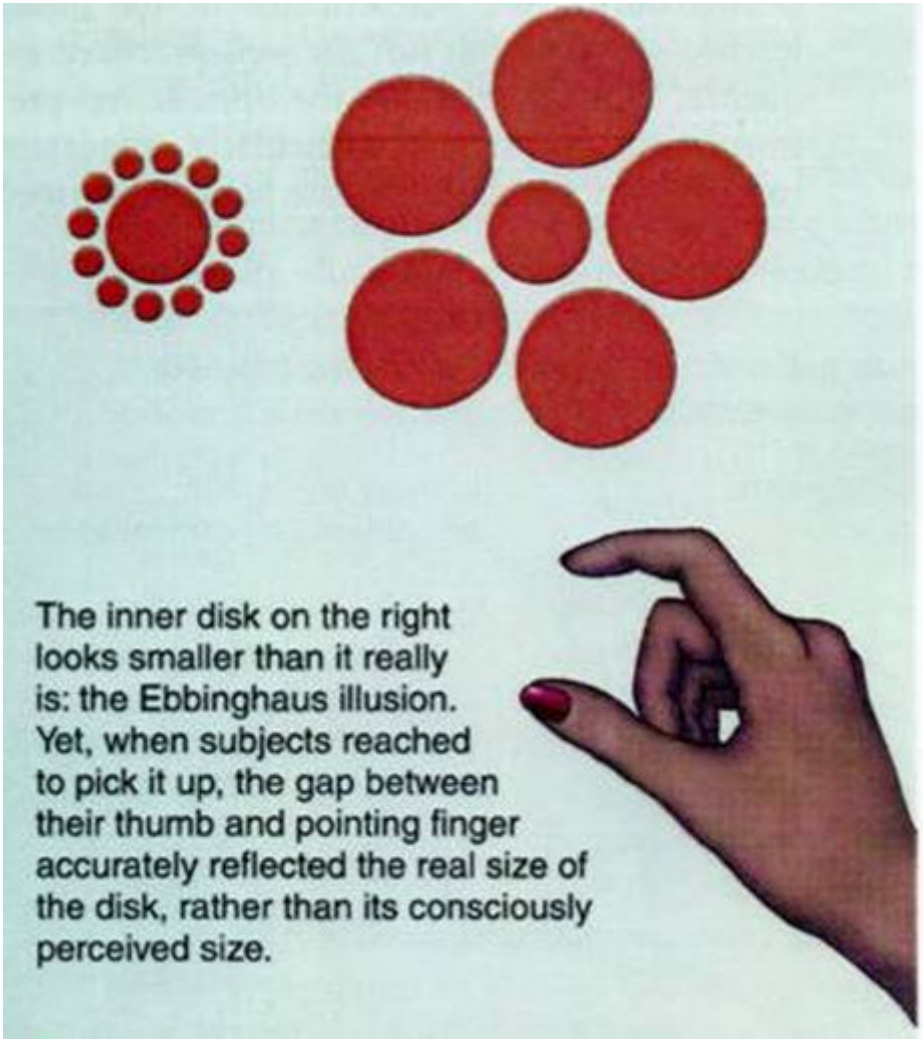
A monkey with lesions in the pareital cortex is unable to learn that the food is always in the same relative position.

The Ebbinghaus or Titchener circles illusion





There is some dissociation between these two tasks in the brain



The inner disk on the right looks smaller than it really is: the Ebbinghaus illusion. Yet, when subjects reached to pick it up, the gap between their thumb and pointing finger accurately reflected the real size of the disk, rather than its consciously perceived size.

Face recognition

The inferior temporal cortex

Some of the neurons in the inferior temporal cortex are tuned to faces. Prosopagnosia is a disorder of face perception where the ability to recognize faces is impaired while the ability to recognize other objects may be relatively intact.

Inability to Visualize Faces

My Prosopagnosia isn't as severe as some people, because I've never had trouble recognizing family members or people close to me. However, I still have an inability to visualize faces of almost anyone. I can visualize places and objects, but it is hard to recall visual images of faces without looking at photos or people themselves. This applies even to people that I do recognize.

Grandmother cells or distributed coding

The fact that some neurons in the inferior temporal cortex respond only to a very narrow group of stimuli such as upwardly held paws or particular faces has led to the grandmother cell hypothesis. This is the idea that perception takes place though neurons that are narrowly tuned for objects that are in the world i.e. we would have a grandmother cell that only responds to visual presentations of grandmother. The opposite theory is the fully distributed theory according to which every neuron in the inferior temporal cortex responds to all stimuli. As usual the truth probably lies somewhere in between i.e. with sparse distributed coding – each neuron responds to some but not all types of visually presented stimuli.