

## Lecture 6

### Cortical visual pathways and the functions of vision

**Reading**

- Bruce, Green and Georgeson, Visual Perception, Chapter 3, pp. 57-74

- Eysenck & Keane, Cognitive Psychology, Chapter 2, pp. 43-51; Chapter 3, pp. 62-65; 69-71.

## Primary visual pathways (see lecture 2)

From the retina to the primary visual cortex

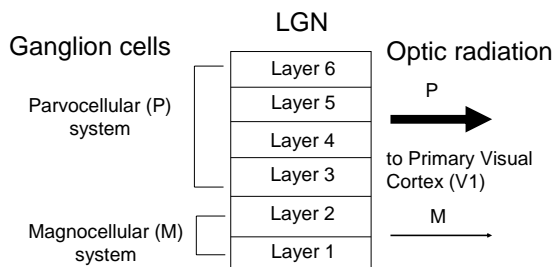
- Ganglion cells (optic nerve)
- Lateral Geniculate Nucleus (optic radiation)
- Primary visual cortex (V1 or striate cortex in occipital lobe)

### This lecture

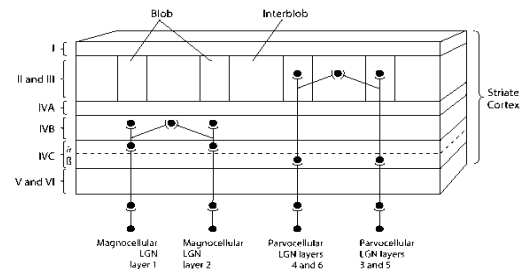
- functions of cortical visual areas
- cortico-cortical pathways

From primary visual cortex to parietal and temporal cortex

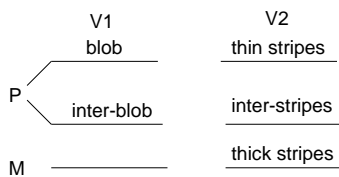
### The organisation of the Lateral Geniculate Nucleus(LGN)



### Segregation of M and P systems in V1



The segregation of M and P systems can be observed in V2 (prestriate cortex) on the basis of staining techniques



Whether these different pathways are completely independent is controversial

### Functions of the M and P systems

On the basis of single cell recordings

Magnocellular pathway  
movement  
direction  
speed

Parvocellular pathway

P-blob pathway  
colour

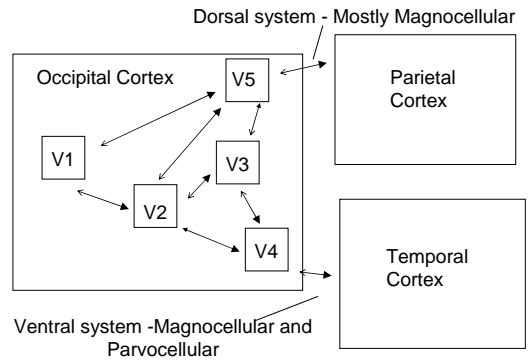
P-interblob pathway  
location  
orientation

Lesion studies (e.g. Logothetis & Charles, 1990)

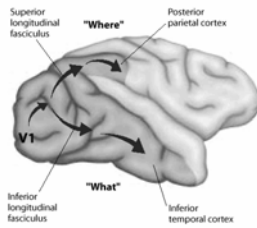
Lesions of magnocellular system  
impaired movement detection

Lesions of parvocellular system  
impaired perception of:  
colour  
texture  
fine details of objects

### Beyond the primary visual cortex



### “What” and “Where” systems in the cortex

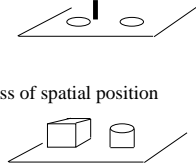


### Dissociation of “what” and “where” systems in the cortex

Ungerlinder & Mishkin (1982)

parietal lesions - dorsal system  
impairment of spatial information processing  
e.g. identify location near landmark

temporal lesions - ventral system  
impairment of feature processing  
e.g. identify object regardless of spatial position



Milner & Goodale (1995)

Alternative hypothesis about ventral and dorsal functions

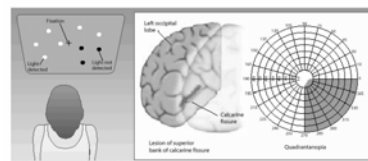
ventral = “what” system  
vision for awareness

dorsal = “how” system  
vision for action

### Is vision without awareness possible?

Cortical blindness (scotoma)

- damage of part of primary visual cortex
- blindness for corresponding part of visual field



## Blindsight

Weiskrantz (1986)

Patient D.B.

Removal of most right striate cortex

Patient unaware of presence of target in blind portion of visual field

Forced trials

- direct gaze to target location
- point to target location

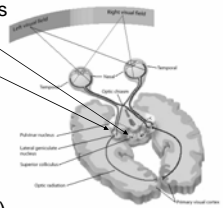
ability to locate target within blind portion of visual field

inability to locate target when presented in blind spot of retina

## Traditional explanation of blindsight

Intact sub-cortical circuits

superior colliculus  
pulvinar



Milner and Goodale (1995)

fibres from sub-cortical structures bypass V1 and connect to dorsal system

## Neuropsychological evidence

Visual agnosia

- damage of occipito-temporal cortex
- inability to recognise objects
- almost unimpaired navigational skills

Optic ataxia

- damage of posterior parietal cortex
- failure to reach accurately for objects
- unimpaired recognition of the same objects
- difficulty in positioning fingers or adjusting grip

## Patient D.F. (Goodale et al., 1991)

Inability to recognise size, shape and orientation of visual objects

Poor shape recognition of real objects

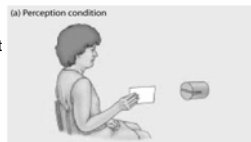
Spared tactual recognition

Spared colour vision

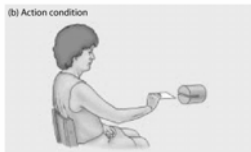
Presented with blocks of different dimensions  
unable to distinguish between them  
unable to indicate their width

When asked to reach for the blocks  
able to scale appropriately her grip

Failure to report the orientation of the slot  
Failure to match the orientation of a target



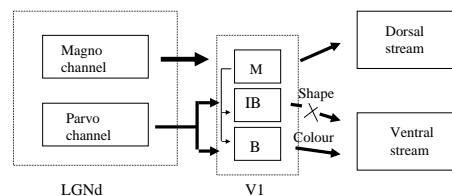
(b) Action condition



Able to insert a card into the slot

(Milner and Goodale, 1995)

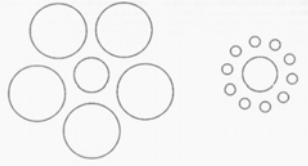
Possibly IB and B compromised in D.F.



Dissociation between perception for awareness  
and perception for action in healthy participants

e.g. (Carey, 2001)

Perception for awareness  
size illusion



Perception for action  
grip not affected by  
illusion

Evidence not always conclusive

Reinterpretation of the function of ventral and dorsal systems  
perceptual representation  
visuo-motor control

Is it possible to reconcile traditional and ecological  
theories of perception?

Traditional

function of perception = construct representations  
conceptually driven  
relationships between objects (allocentric)

Ecological

function of perception = action guidance  
data driven  
relationship between observer and objects (egocentric)

Summary

- Cortico-cortical visual pathways
- What and where: dorsal - ventral dichotomy
- What and how:
  - dorsal - ventral dichotomy reinterpreted
  - perception – action
- Can ecological and traditional approaches be reconciled?