

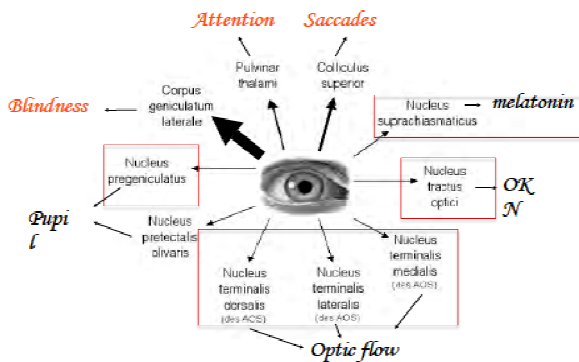
Kognitív idegtudomány

Introduction to neurosciences for MAs.

Látás 3.

V1

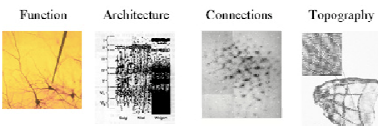
Miről NEM beszéltünk?



What is a visual area?

PhACT:

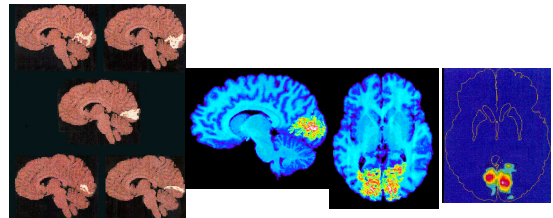
- Physiology
- Architecture
- Connections
- Topography

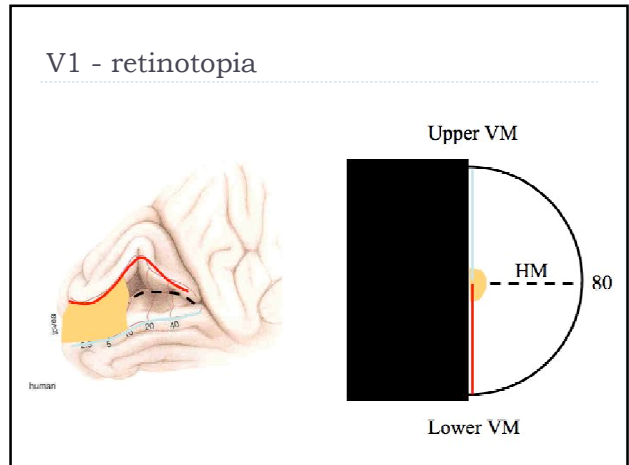
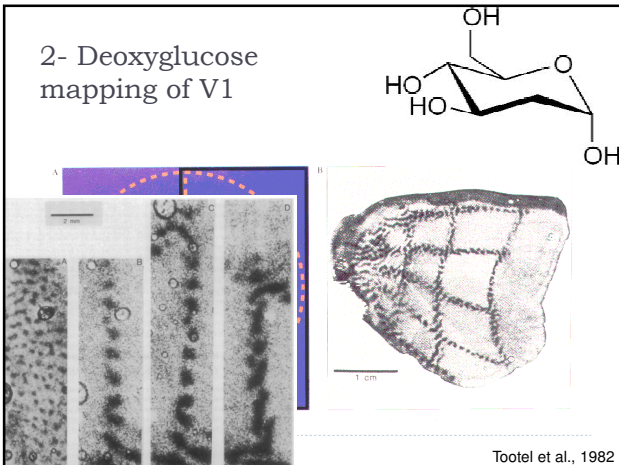
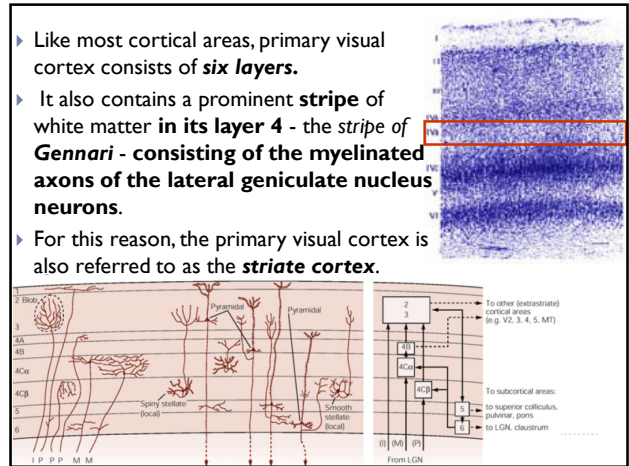
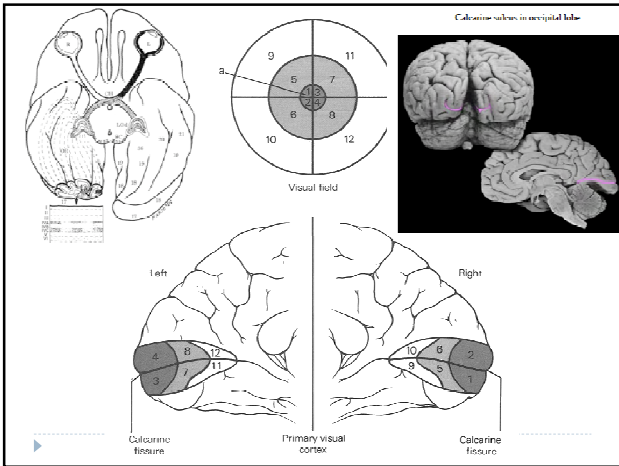
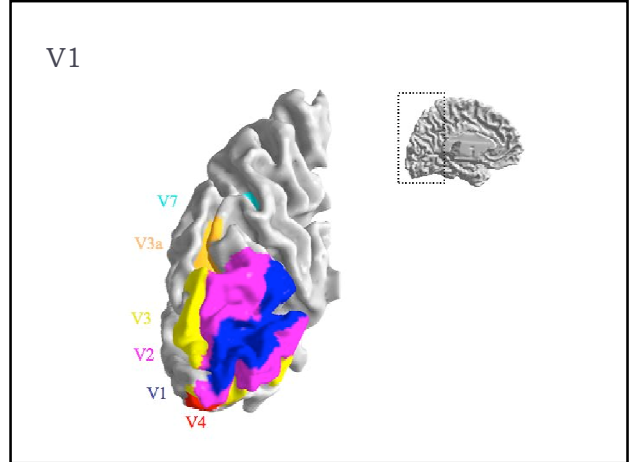
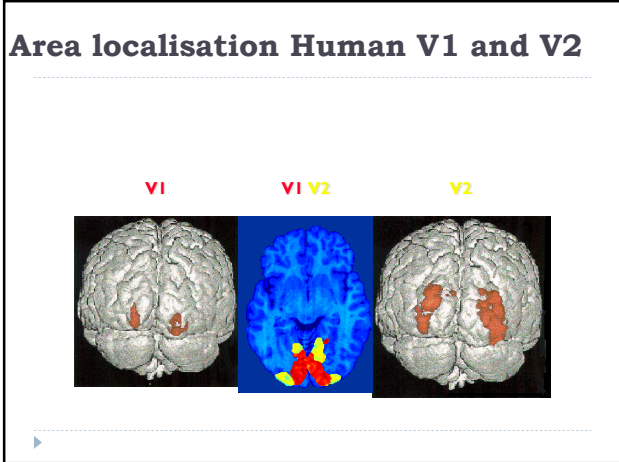


Primary visual cortex

- ▶ (Brodmann's area 17, or striate cortex).
- ▶ Located on occipital lobe of brain.
- ▶ Total area about the size of your palm, about 1/2 of region is devoted to fovea and parafoveal inputs.
- ▶ Receptive fields: spots, lines, moving lines.

Area localisation Human V1: quantitative cytoarchitectonic





How to make retinotopic mapping ?

578 *S.O. Dumoulin et al. J Neuro*

Fig. 2. Spatial layout of the visual stimuli used. Stimuli used for phase-coded retinotopic mapping of polar-angle (a) and eccentricity (b). The checks in the wedge and annulus were contrast reversing at 8 Hz. The entire wedge and annulus were rotating and expanding, respectively, at a rate of 0.03 Hz.

Engel et al. Nature (1994)

Retinotopy: radial component

Human Monkey

Brewer, Wandell, & Logothetis

Retinotopy: angular component

Human Monkey

Cortical magnification

Retinal image Cortical map

Columnar architecture of V1

Retinotopic map

Columnar architecture

1 mm

Columnar architecture

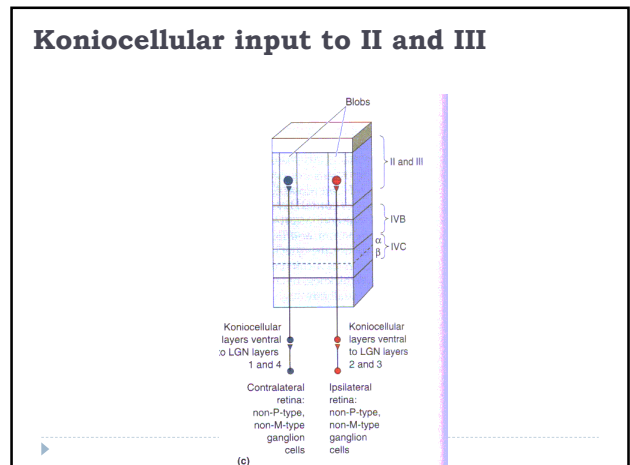
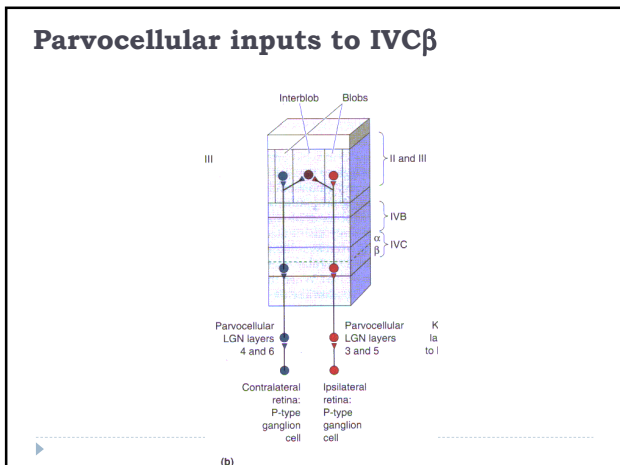
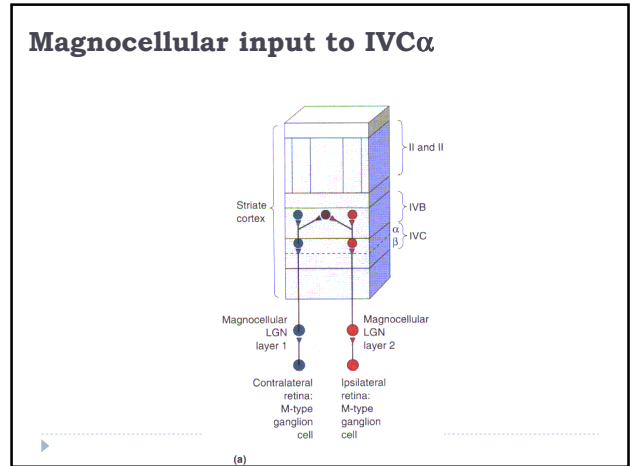
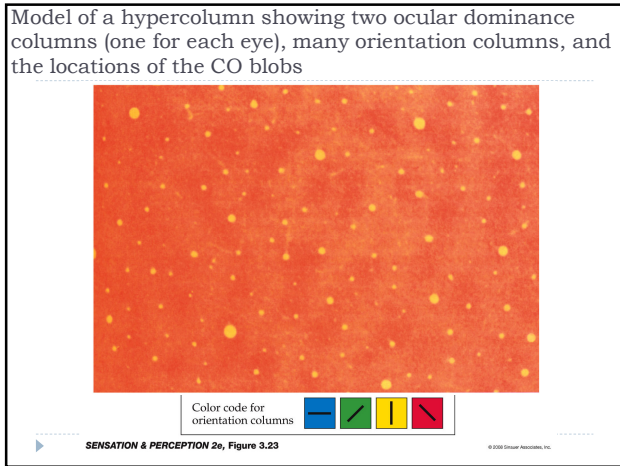
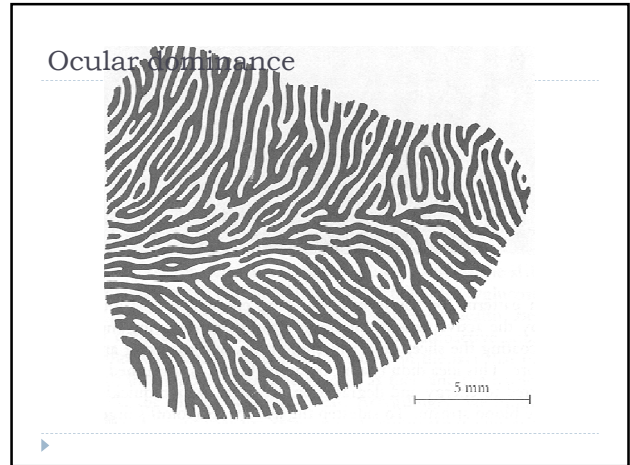
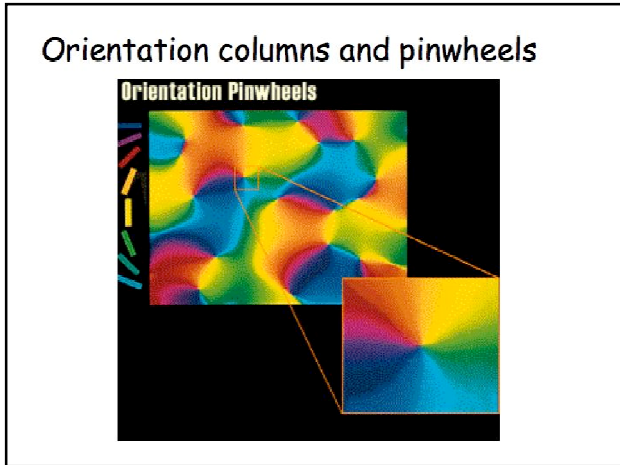
Perpendicular electrode penetration: same orientation preferences and ocular dominance.

Tangential electrode penetration: orientation preference and/or ocular dominance varies.

Surface

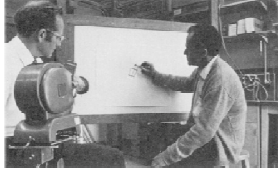
White matter

1 mm



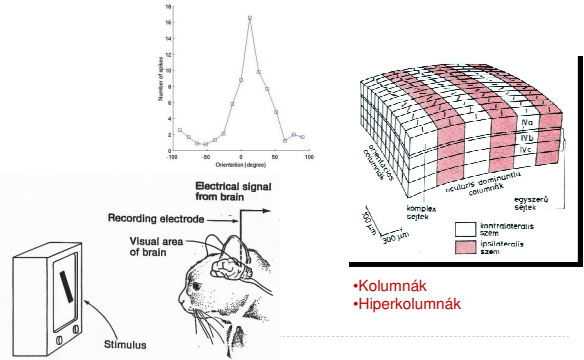
Orientation selectivity

David Hubel és Throsten Wiesel

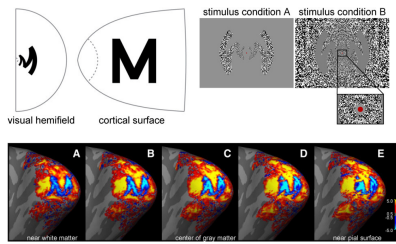


See movies...

A jégkocka modell

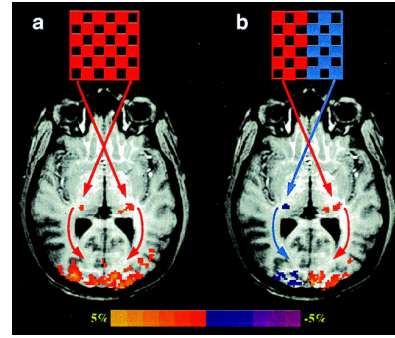


A V1-beli reprezentáció



Polimeni et al., (2010). Laminar analysis of 7 T BOLD using an imposed spatial activation pattern in human V1. *Neuroimage*, 52, 1334-1346.

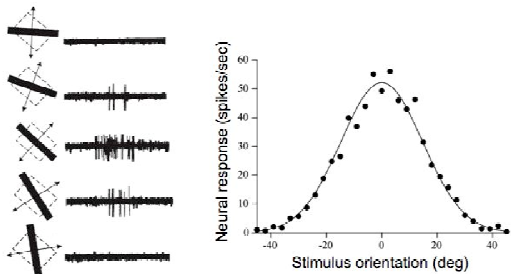
fMRI mapping of the LGN and V1 activation from subject 2 during the left-right hemifield visual stimulations from a different experimental session and the axial image orientation.



Chen W et al. PNAS 1999;96:2430-2434

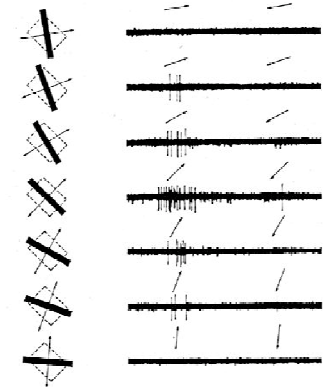
PNAS

V1 physiology: orientation selectivity



Hubel & Wiesel, 1958

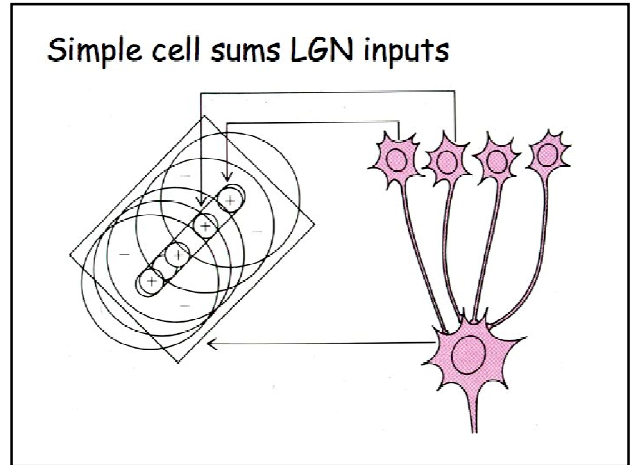
V1 physiology: direction selectivity



Simple cell

- respond best to elongated bars or edges.
- are **orientation selective**.
- can be **monocular or binocular**.
- have **separate ON and OFF subregions**.
- perform **length summation** (they have bigger responses with increasing bar length up to some limit, at which point the response reaches a plateau).

Stimulus: on off



Two flavors of simple cells: (a) an edge detector and (b) a stripe detector

(a) Edge detector

(b) Stripe detector

SENSATION & PERCEPTION 2e, Figure 3.19 © 2008 Sinauer Associates, Inc.

Complex cell

- orientation selective**.
- spatially homogeneous receptive fields (no separate ON/OFF subregions)**.
- nearly all binocular**.
- perform **length summation**

Stimulus: on off

Hypercomplex cell

Impulses per second

Stimulus length (degrees)

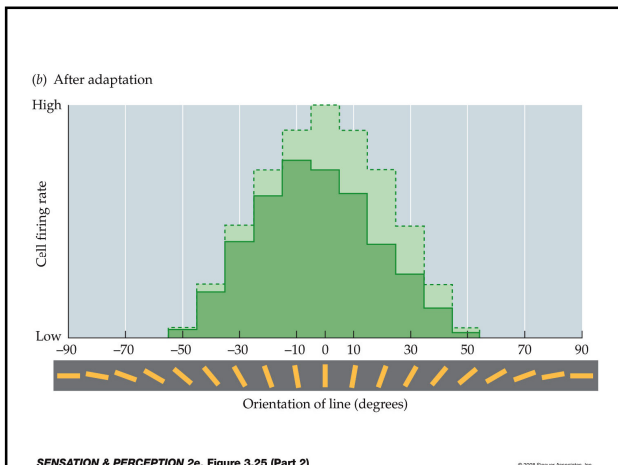
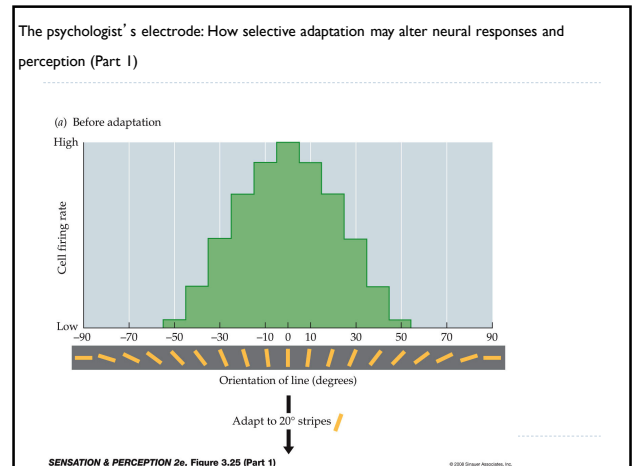
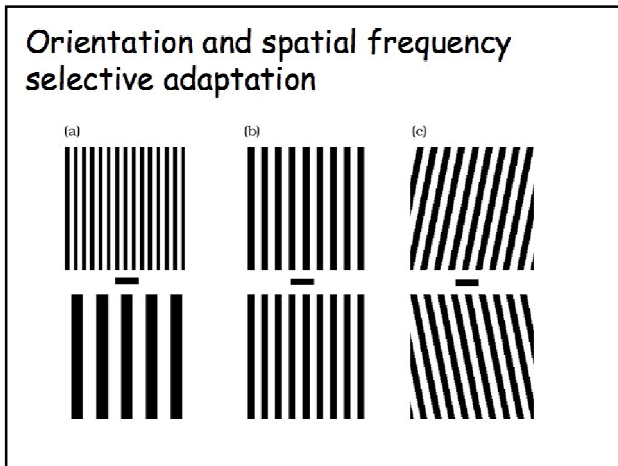
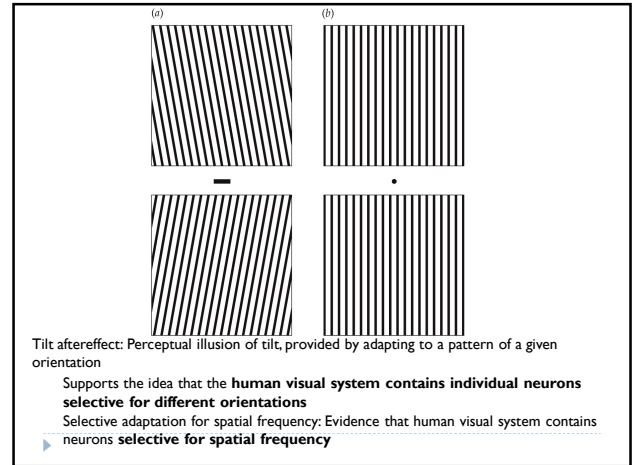
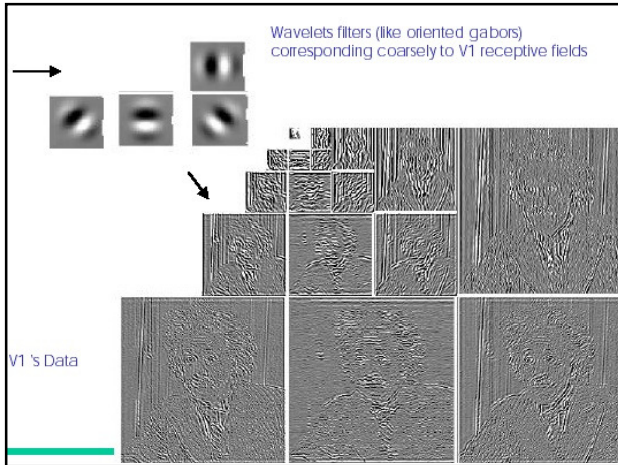
End-stopping

Receptive Fields in Striate Cortex

Receptive field

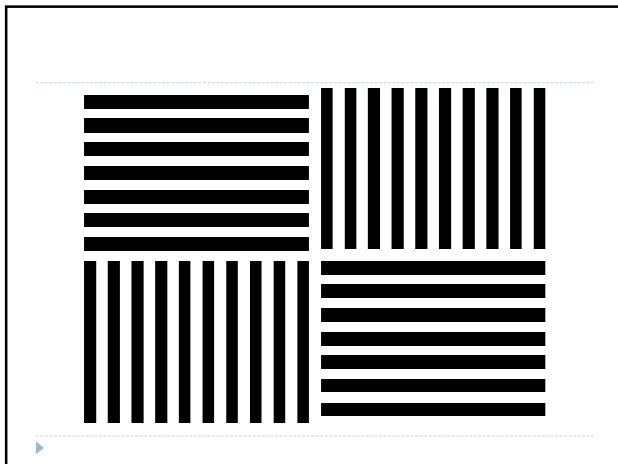
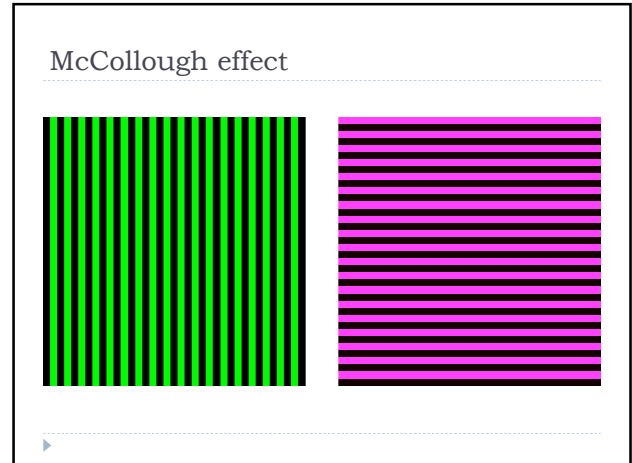
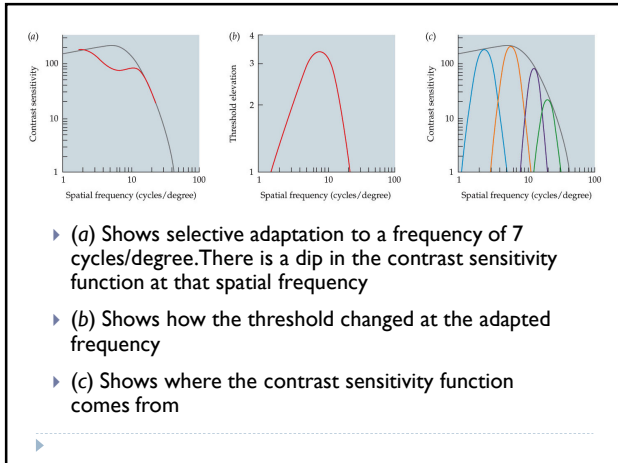
Stimulus

▶ **End stopping:** Some cells prefer **bars of light of a certain length**

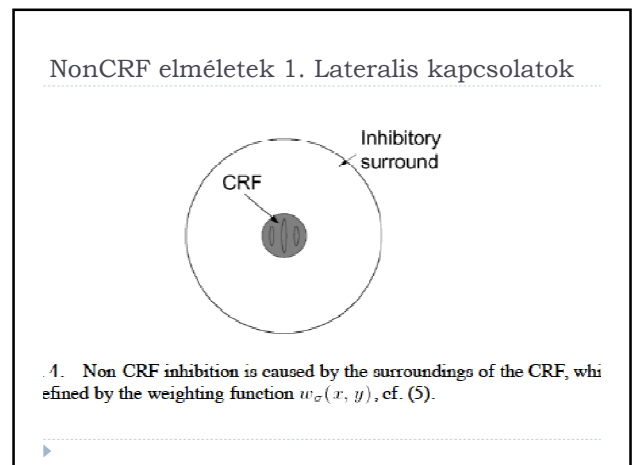
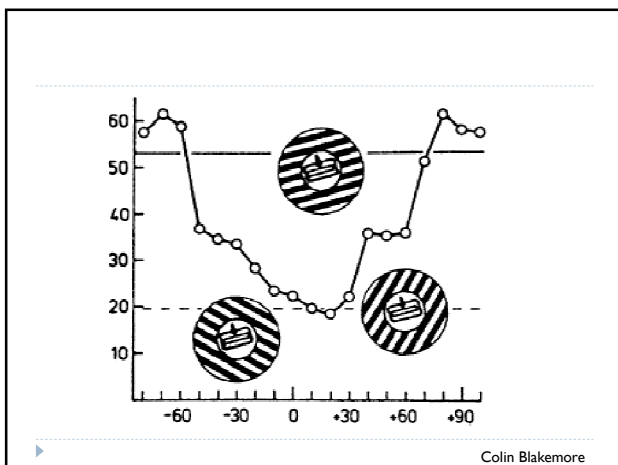


Selective Adaptation

- ▶ Adaptation experiments provide strong evidence that **orientation and spatial frequency are coded separately by neurons in the human visual system**
- ▶ Cats and monkeys: Neurons in **striate cortex, not in retina or LGN**
- ▶ Humans operate the same way as cats and monkeys with respect to selective adaptation




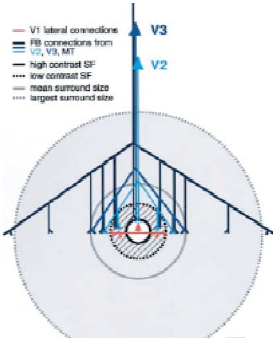
NON-classical RF



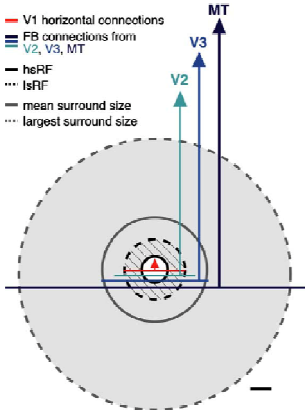
NonCRF elméletek 2. Feed-back

Summation field and surround

Alessandra Angelucci

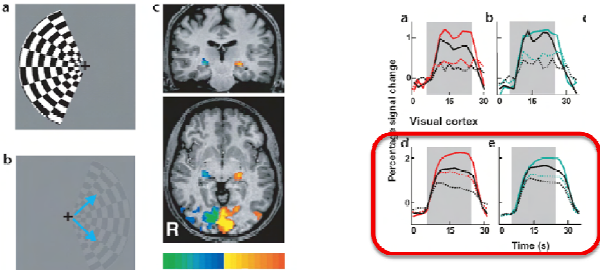
- V1 lateral connections
- FB connections from V2, V3, MT
- high contrast SF
- low contrast SF
- mean surround size
- largest surround size



- V1 horizontal connections
- FB connections from V2, V3, MT
- hRF
- lsRF
- mean surround size
- largest surround size

Attention and V1

Oconnor et al, 2002 Nature Neurosci.

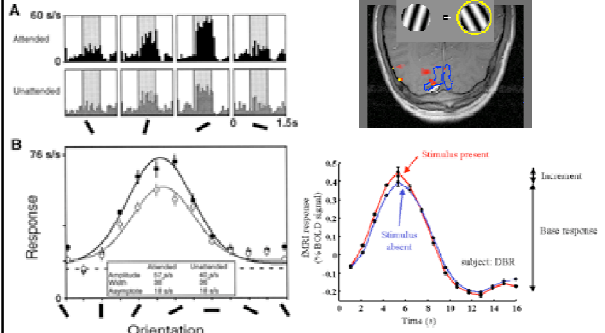


Visual cortex

Red- attending to stimuli (black -control)
Green -easy central task Black: heavy central task.

Attention and V1

Gandhi, Heeger, & Boynton, PNAS (1999)



60 s/s
Attended
Unattended

76 s/s
Response
Orientation

Increment
Base response

subject: DHR