

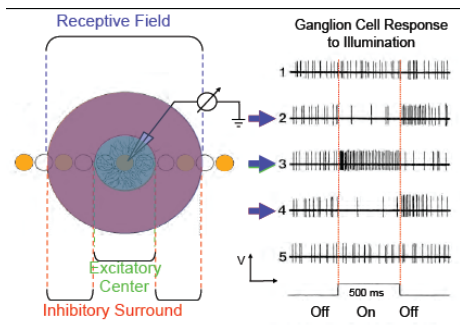
<http://cogsci.bme.hu/~gkovacs/gyulakovacs/Teaching.html>

Kognitív idegtudomány

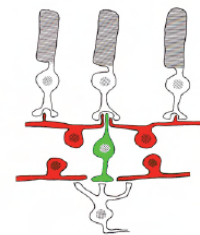
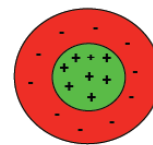
Introduction to neurosciences for MSs.

Látás 2.

A retinától a V1-ig.

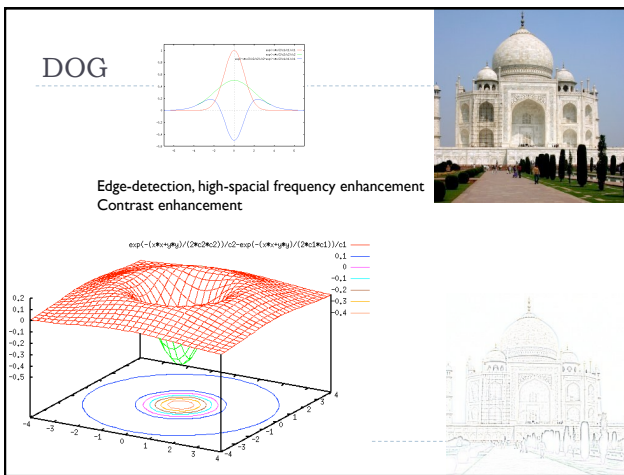
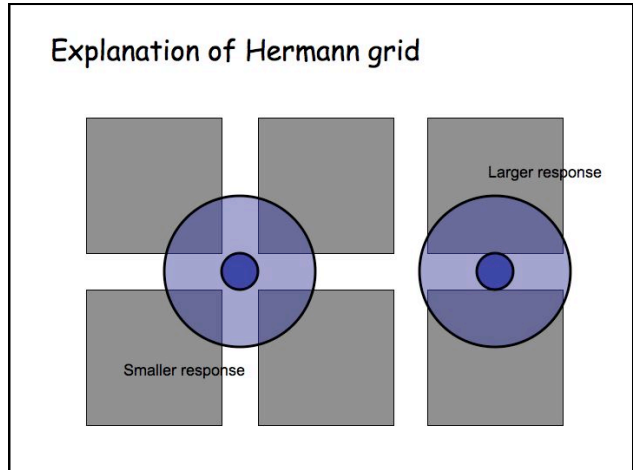
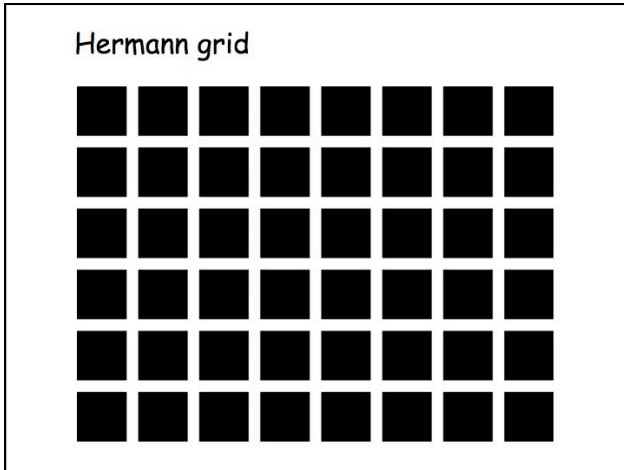


The Receptive Field has a Center and a Surround

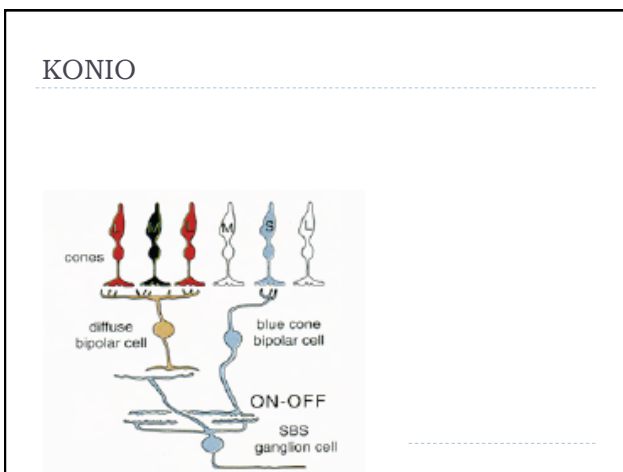
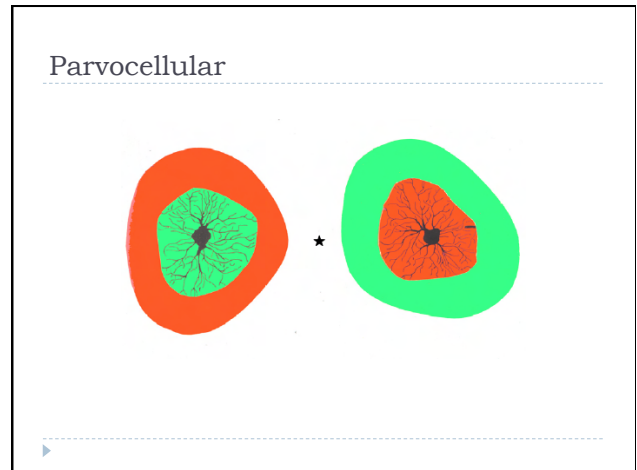
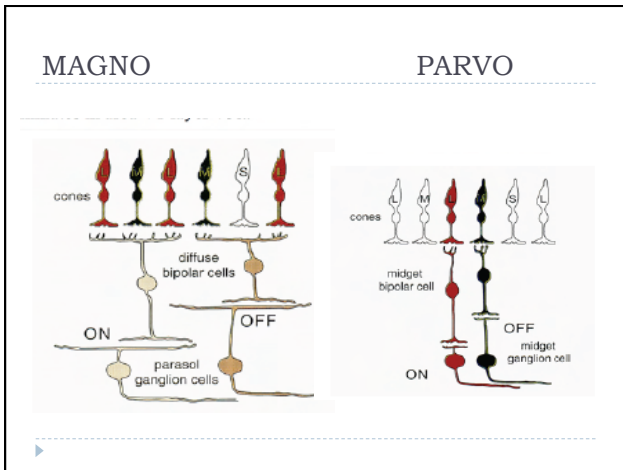


Concentric RF structure with a "center" and an antagonistic "surround" (ON-center/OFF-surround, or vice versa).

This structure can be modeled by the difference of two scaled Gaussian functions and is therefore known as a difference-of-gaussians (DOG) receptive field.



- ### Pathways to cortex
- ▶ **50% magnocellular / parasol ("brisk-transient")**
 - ▶ Wide dendritic field, transient bipolar input, low threshold, low spatial and high temporal frequencies, low sampling density, project to superior colliculus and magnocellular layers in LGN. (Layer 4Calpha in V1)
 - ▶ **40% Parvocellular / Midget ("brisk-sustained")**
 - ▶ Narrow dendritic field, combines transient and sustained BCs, high spatial and low temporal frequencies, high sampling density, project to parvocellular layers in LGN (Layer 4Cbeta in V1).
 - ▶ **5% Koniocellular / Bistratified and unknowns**
 - ▶ Input from S-cone ON BC and OFF M-cone and L-cone BCs, discards spectrally correlated in favor of spectrally anti-correlated information ("blue minus yellow"), projects to koniocellular layers in LGN. (V1 layer2-3, MT)
 - ▶ **5% "sluggish" cells**
 - ▶ Firing rates 10-fold lower; thin axons cover 5% of cross-section of optic nerve, presumably different coding strategies (special purpose detectors?).

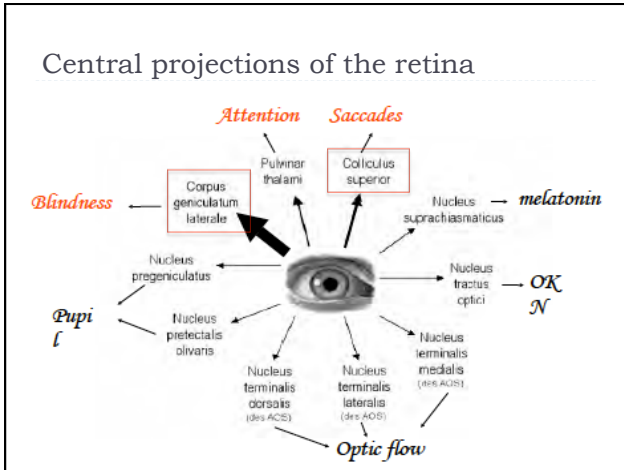


Post retinal pathways

- ▶ **Optic Nerve:** 1.2 million ganglion cell axons (myelinated optic nerve fibers)/nerve.
- ▶ **Optic Chiasm:** partial decussation of optic nerve fibers (nasal fibers project contralaterally, temporal fibers project ipsilaterally). Thus, left side of brain looks at right visual world; right side of brain looks at left visual world.

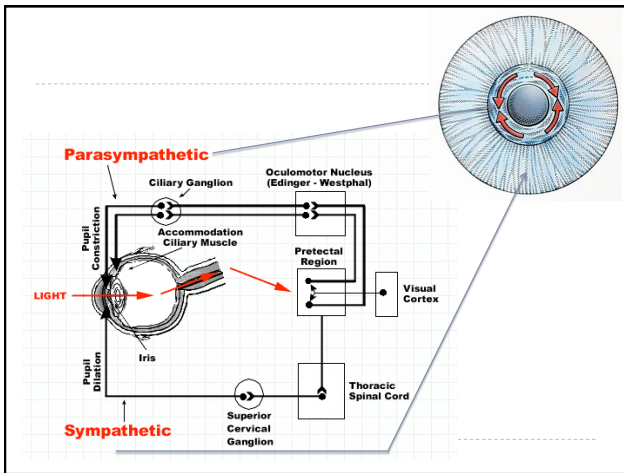
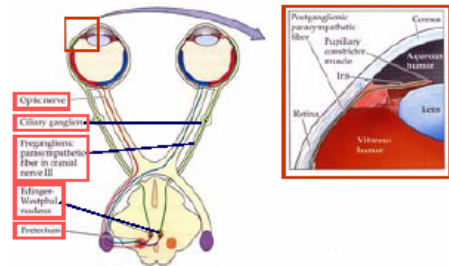
Posterior View of Eye: The Optic Nerve and Its Covering Membranes

Central projections of the retina



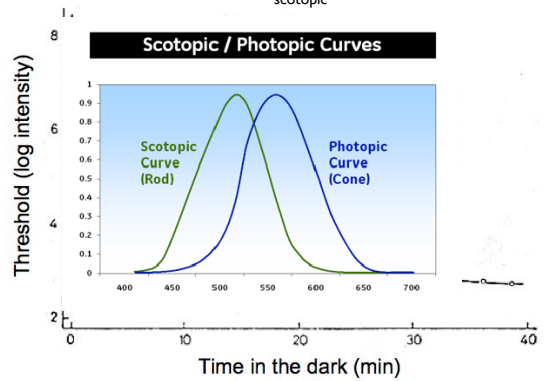
Pretectum & Pupillary Light Reflex

The pretectum controls the action of the pupillary constrictor muscle (iris sphincter muscles) via its projection to both Edinger Westphal nuclei. (n. Oculomotor. III) Parasimp. Atropin?



Dark adaptation

Photopic
Mesopic
scotopic

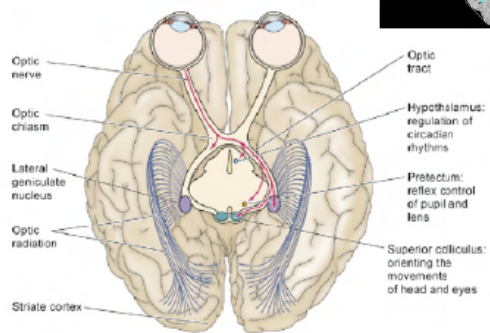


Mechanisms of light/dark adaptation

1. Pupil size
2. Switchover between rods and cones
3. Bleaching/regeneration of photopigment
4. Feedback from horizontal cells to control the responsiveness of photoreceptors

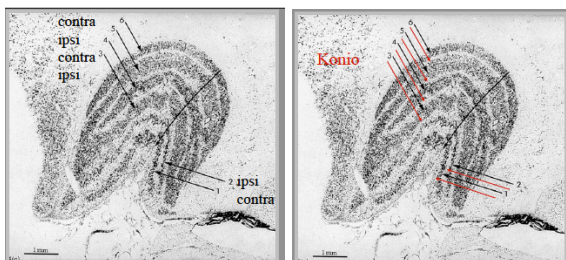


Corpus geniculatum laterale – lateral geniculate nucleus

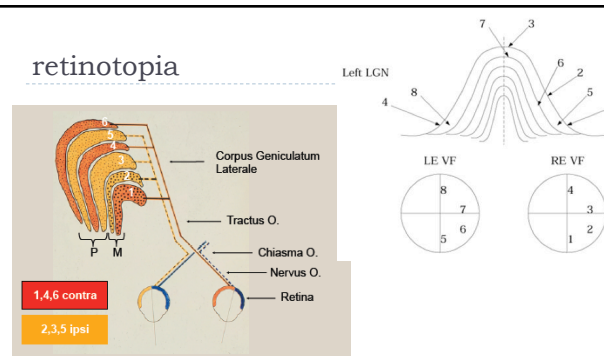


CGL -layers

1,2- M, 2-6 P
C I I C I C



retinotopia



BUT: CGL input jön subkortikális és agykérgi neuronokból is!
Sőt: a CGL bemenetének csak 10 %-a retinális!!!
A többi cortico-thalamikus feed-back és a Colliculus superioriból jön.

CGL – RF properties

Hubel and Wiesel (60s)
Single-cell recordings in anesthetised cats

Hasonló a ganglionsejtekéhez.

Spatial frequency:

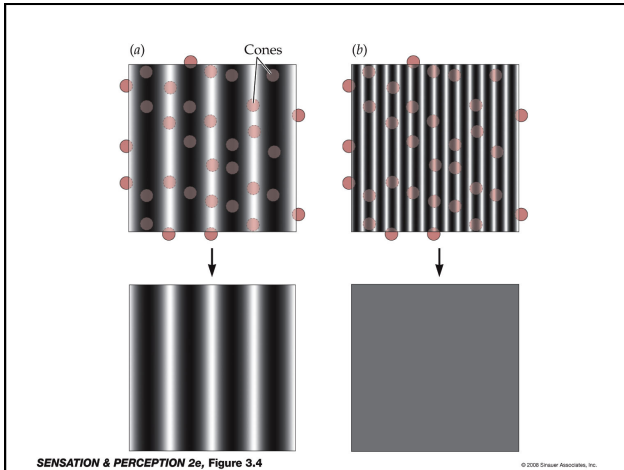
- ▶ The number of cycles of a grating per unit of visual angle (usually specified in degrees)
- ▶ Another way to think of spatial frequency is as the number of times a pattern repeats per unit area

A complete image (a) and simulations of the high-frequency (b) and low-frequency (c) components of that image

SENSATION & PERCEPTION 2e, Figure 3.30 © 2009 Sinauer Associates, Inc.

Why does an oriented grating appear to be gray if you are far enough away?

- ▶ This striped pattern is a “sine wave grating”
- ▶ The visual system “samples” the grating discretely



Retinal Ganglion Cells and Stripes

- ▶ The response (right) of a ganglion cell to gratings of different frequencies (left): (a) low, (b) medium, and (c) high
- ▶ How do the center-surround receptive fields respond to sine wave patterns with different spatial frequencies?

(a) Low frequency yields weak response

(b) Medium frequency yields strong response

(c) High frequency yields weak response

Retinal Ganglion Cells and Stripes

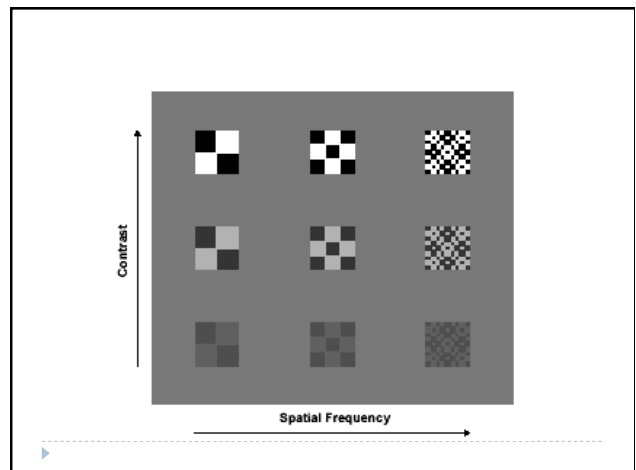
- ▶ Not only is the spatial frequency important, but so is the phase
- ▶ Phase: The phase of a grating refers to its position within a receptive field

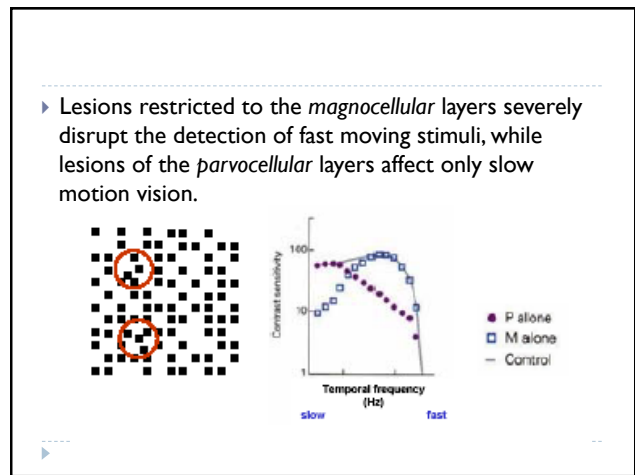
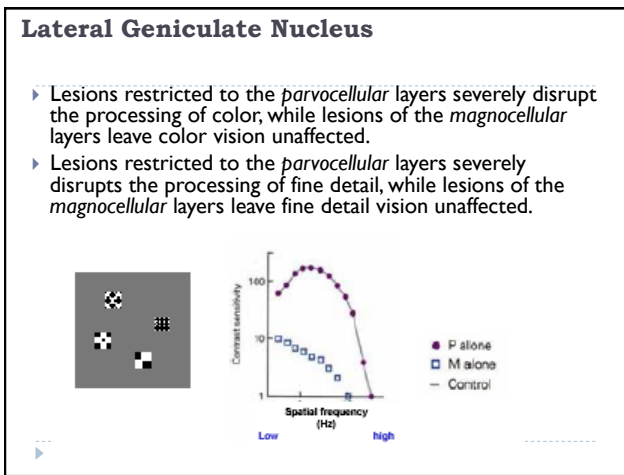
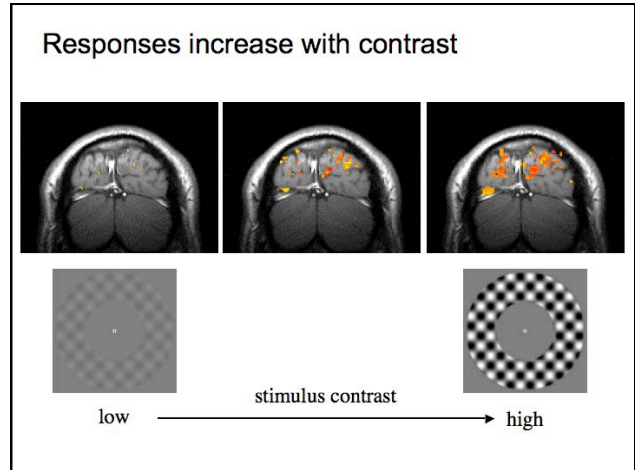
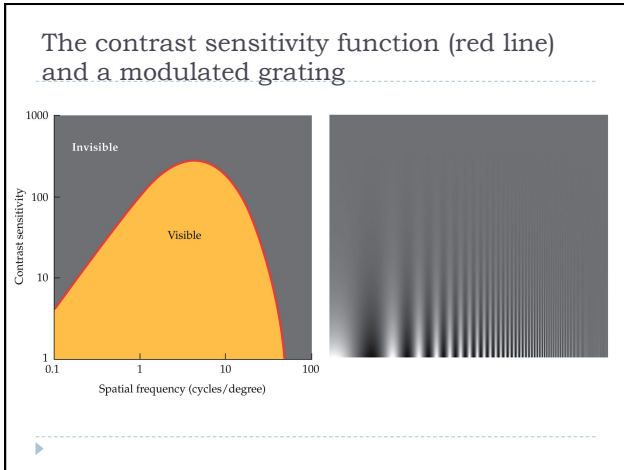
(a) 0° - Positive response

(b) 90° - No response

(c) 180° - Negative response

(d) 270° - No response



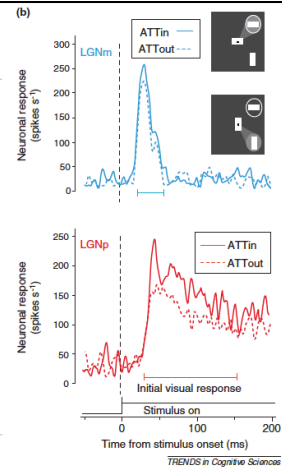


Non-linearity of CGL RFs

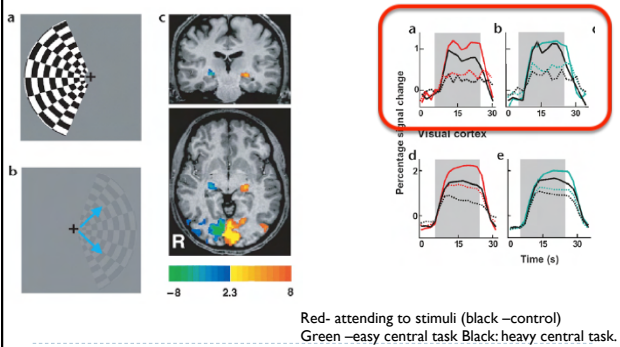
- ▶ Gain-control: changing the relationship between the input and the output of a neuron
- ▶ The average output signal level is **fed back** to adjust the **gain** to an appropriate level for a range of input signal levels.
- ▶ A relevant example is the increased responsiveness of a neuron representing an attended stimulus.

Attention

Figyelem növeli a válasz amplitúdóját
A CGL P és M rétegeinek neuronjaiban is



Oconnor et al, 2002 Nature Neurosci.



A hatás thalamo-cortico-thalamikus

- ▶ Thalamic reticular nucleus (TRN)
 - ▶ Part of the visual thalamus
 - ▶ Feed-back kapcsolat a kéregből:
 - ▶ Cortico-TRN-CGL-Cortico loop.
 - ▶ VI szinapszisok:
 - 5-10 % CGL bemenete
 - 70% local kapcsolatok
 - 25 % feed-back magasabb kérgi területekről.

Relay cells and inhibitory interneurons

TRN: inhibitory input and generation of "sleep spindles"

Feedback from cortex of unclear function

Modulatory input from brainstem

Pulvinar

Kapcsolatok:

Input:
Visual cortex
CS

Output:
Visual cortex
Assoc. cortex
?

Pulvinar és figyelem

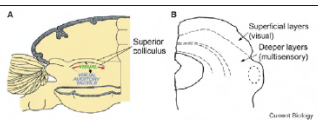
- ▶ Figyelem mintegy 25%-al növeli a PUL neuronok aktivitását majmokban.
- ▶ Léziója neglelkezh vezeteth
- ▶ Erős kapcsolatban van az ún figyelmi hálózáttal (prefrontal, parietal, sc etc...)
- ▶ Szerepe LEHET a vaklátás kialakulásában....
- ▶ Globális mozgás
- ▶ Figyelmi előkészítés?

Kastner et al, 2004

▶ Pulvinar activity increased if subjects payed attention to the stimuli (checkerboard).

Superior colliculus

- ▶ Optic tectum: kétélűekben és halakban ez a legfontosabb átkapcsoló állomás még.



Organized into 7 alternating fibrous and cellular layers:

- Superficial Layers:**
- Stratum Zonale (SZ)
 - Stratum Griseum Superficiale (SGS)
 - Stratum Opticum (SO)

- Deep Layers:**
- Stratum Griseum Intermedium (SGI)
 - Stratum Album Intermedium (SAI)
 - Stratum Griseum Profundum (SGP)
 - Stratum Album Profundum (SAP)

Superficial layers:
Visual.
Shape, movement, targets for saccades

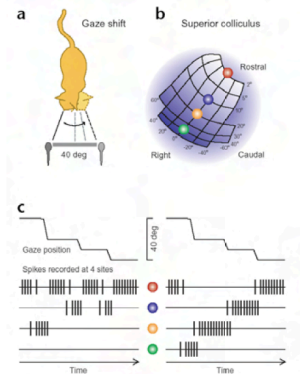
Deep layers:
Multimodal (bi-trimodal)
Visuomotor –saccades
Somatosensory, auditory

RF- multimodal representation of
Body

Szakkádok és figyelmi shift

A szakkád előtt és alatt aktívak csak adott irány és amplitúdó esetén

A figyelt target helyére utal.



Miről NEM beszéltünk?

