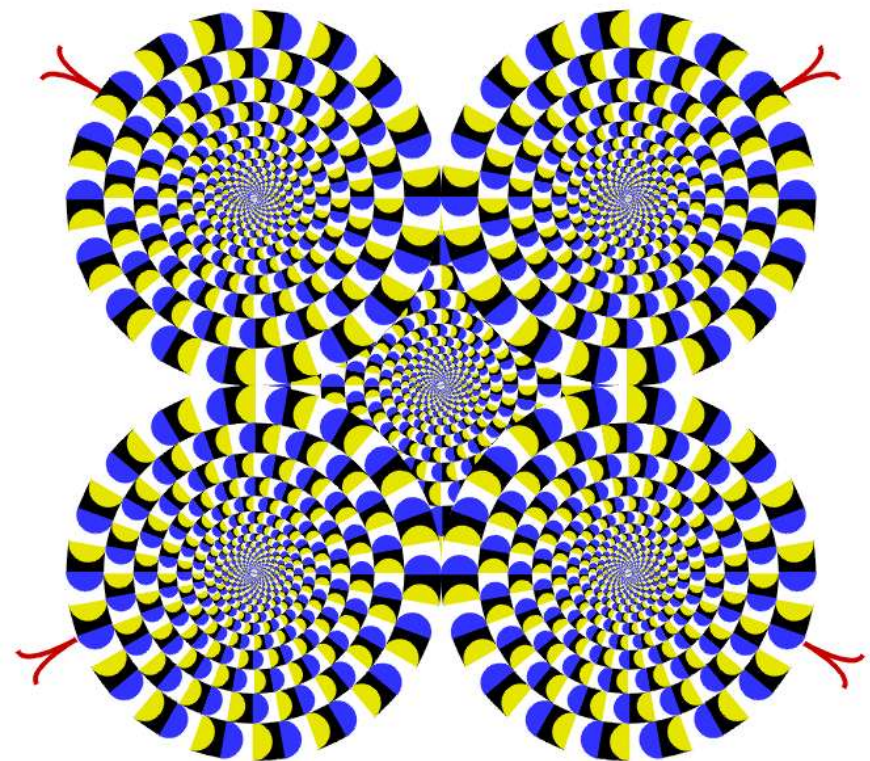




Yves Rossetti, CNRL
INSERM, Equipe Impact



L**a****v****i****S****i****o****n**

1. Psychophysique

Différentes qualités visuelles: lumière, acuité, couleurs, mouvement, profondeur, ...

Seuil absolu : quelques photons seulement !
(seulement dans une petite zone de la rétine, proche fovéa)

Seuil différentiel : l'œil humain peut distinguer env. 40 niveaux de gris.

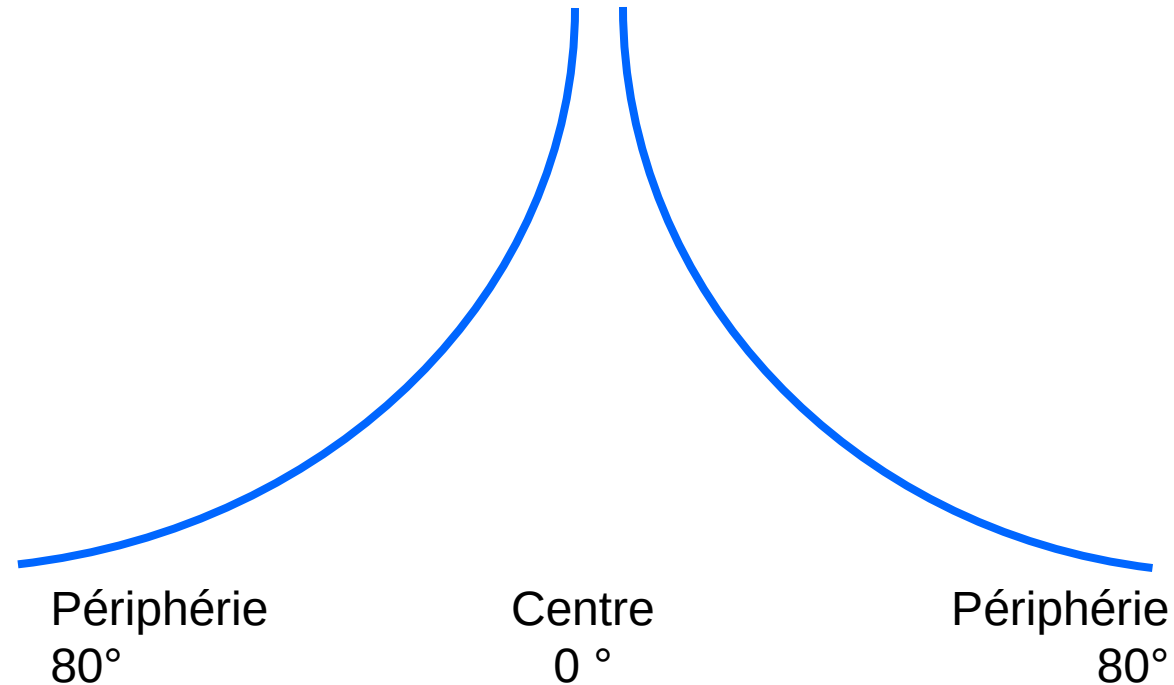
Relativité:

- excentricité rétinienne (selon les qualités visuelles)
- conditions lumineuses (vision photopique et scotopique)
- phénomènes d'adaptation (e.g. à l'obscurité)
- le cerveau crée de l'information (e.g. Marriotte)

NB: l'acuité mesurée habituellement est un pouvoir séparateur (seuil différentiel)

Acuité visuelle

= pouvoir séparateur



Excentricité rétinienne

Résolution temporelle

faible: télévision et écrans = 60 Hz!

Une image toutes les 45 ms suffit à donner l'impression de continuité!
(réflexe myotatique < 25 ms!)

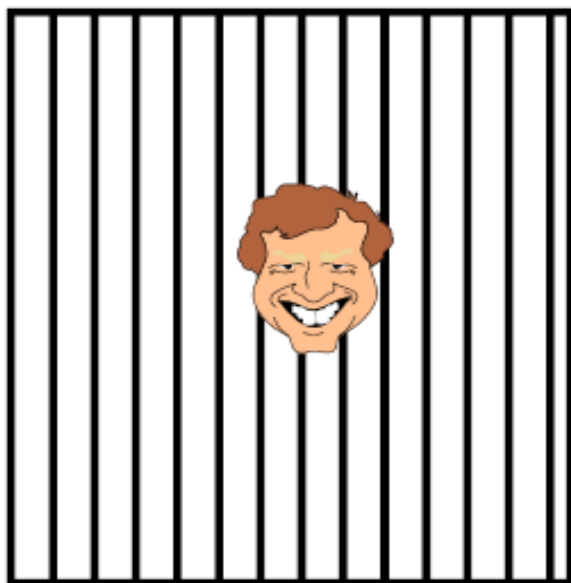
Longueur d'onde

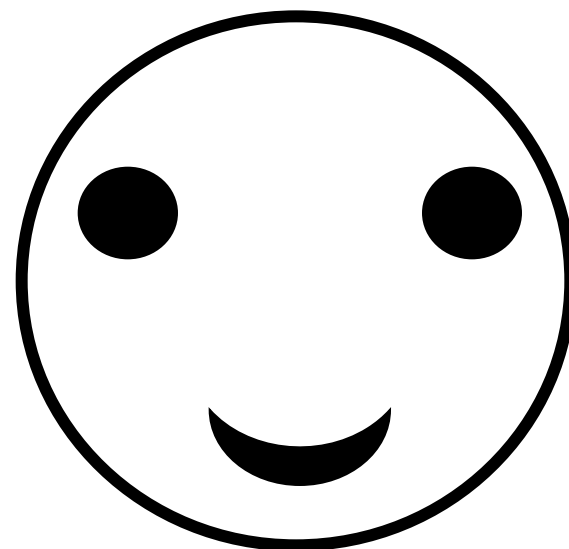
L'homme peut percevoir 200 nuances colorées
continuité des longueurs d'onde, mais fractionnées par les récepteurs rétiniens
(cônes) et le réseau neuronal rétinien, et interprétées comme des couleurs.
La couleur n'existe pas à l'extérieur du SNC

La tâche aveugle: expérience de Mariotte (10 deg à 10 deg)

Ne regarder qu'avec l'œil droit



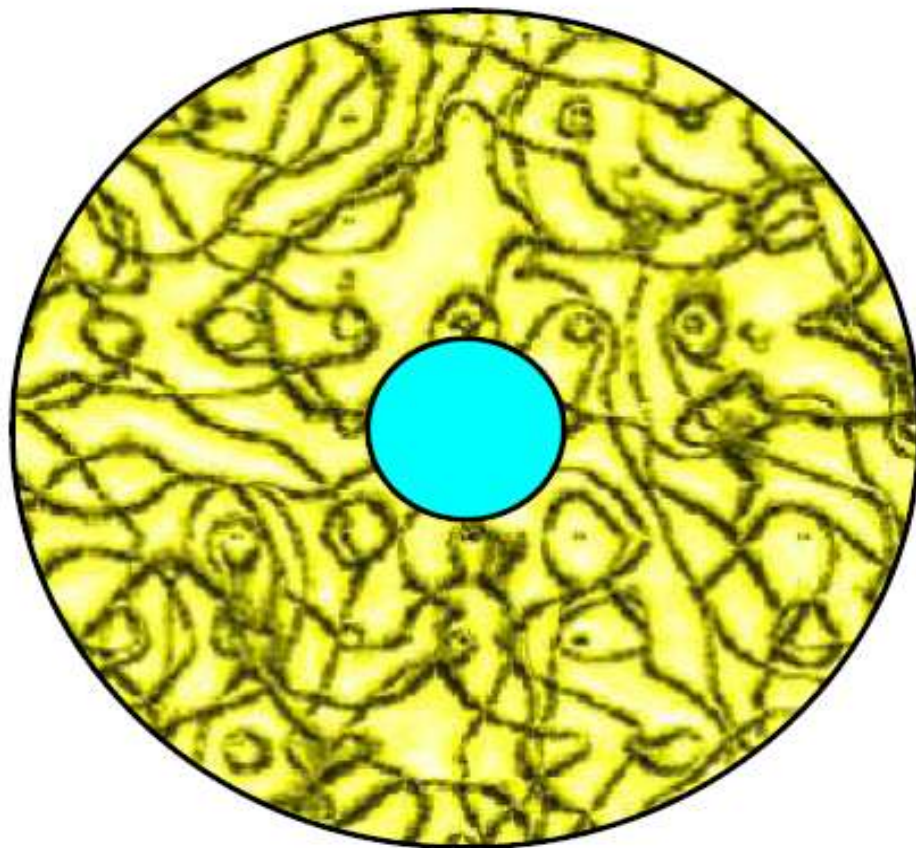






The brain even fills in complex textures.

This illustrates an important principle. The brain often fills in information that is missing. It makes things up the best it can.



2. La rétine

Structure

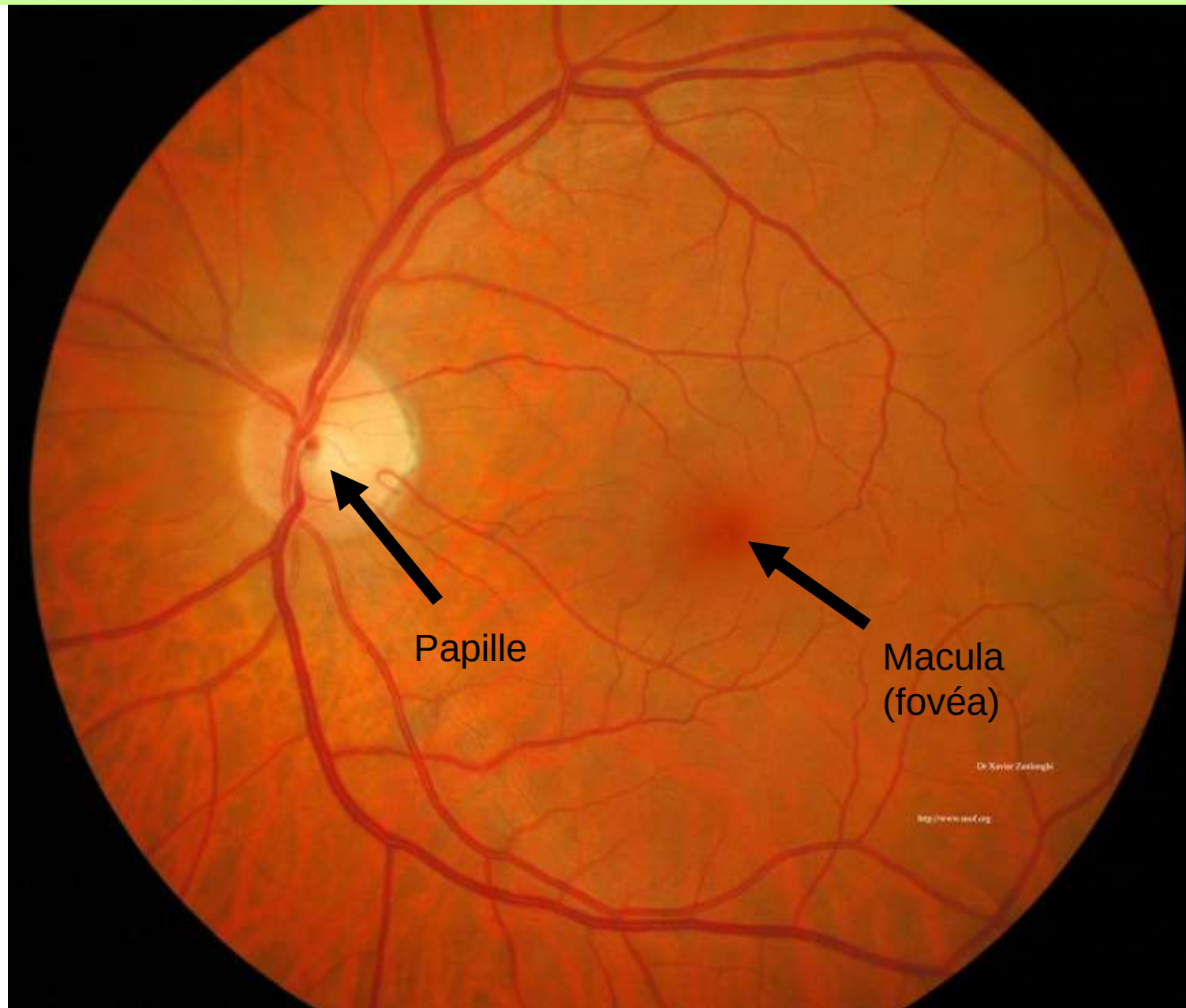
Acuités

Cellules bipolaires

Cellules ganglionnaires

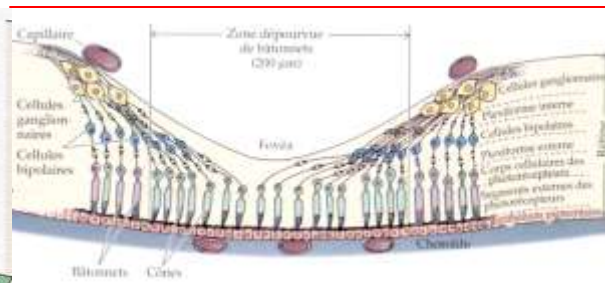
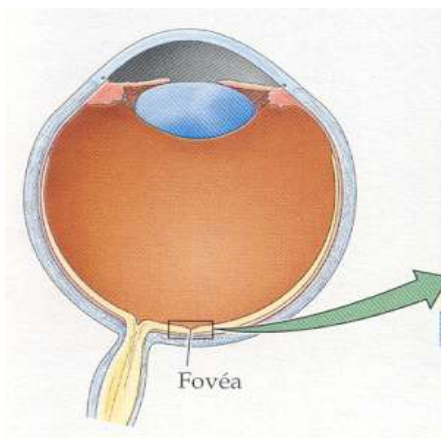
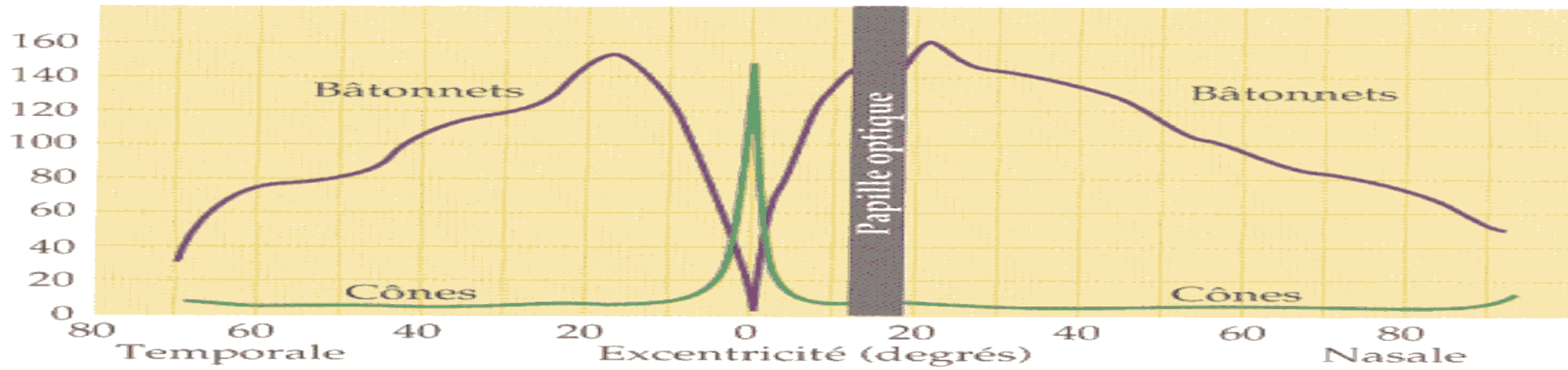


2. LA RETINE



2. LA RETINE

Densité des récepteurs ($\text{mm}^{-2} \times 10^3$)



Périphérie
80°

Centre
0°

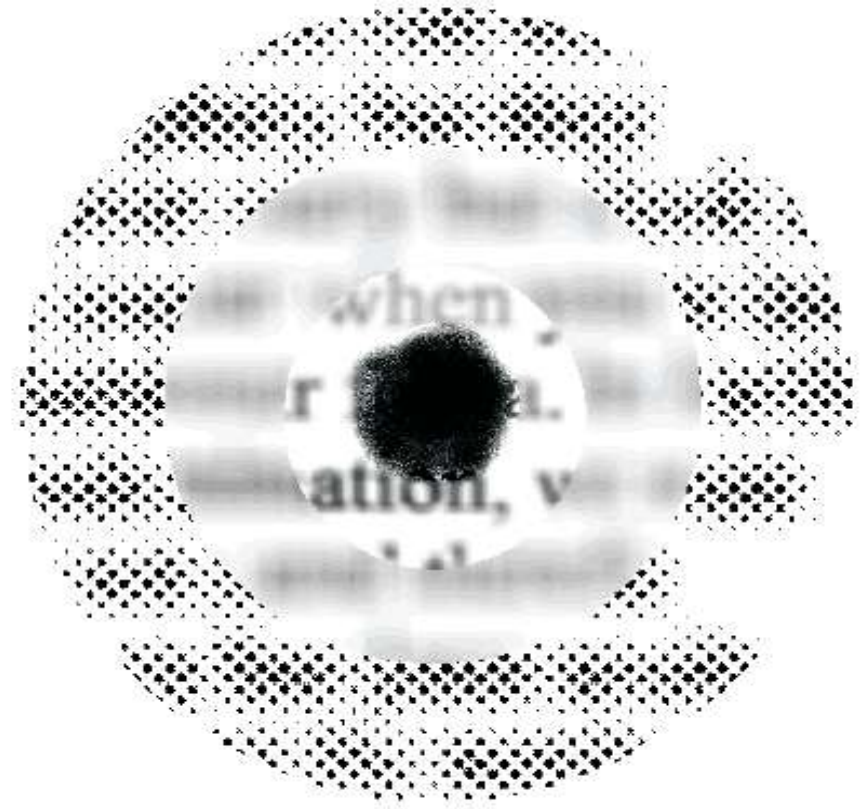
Périphérie
80°

Excentricité rétinienne

2. LA RETINE



En lumière du jour,
seule la fovéa centrale
voit les détails et les couleurs



Dans l'obscurité,
seule la périphérie voit:
en noir et blanc et
avec une faible résolution.
la fovéa est aveugle

2. LA RETINE



La vision centrale



La vision centrale



© Michel Imbert

=> Processus actifs rétiniens



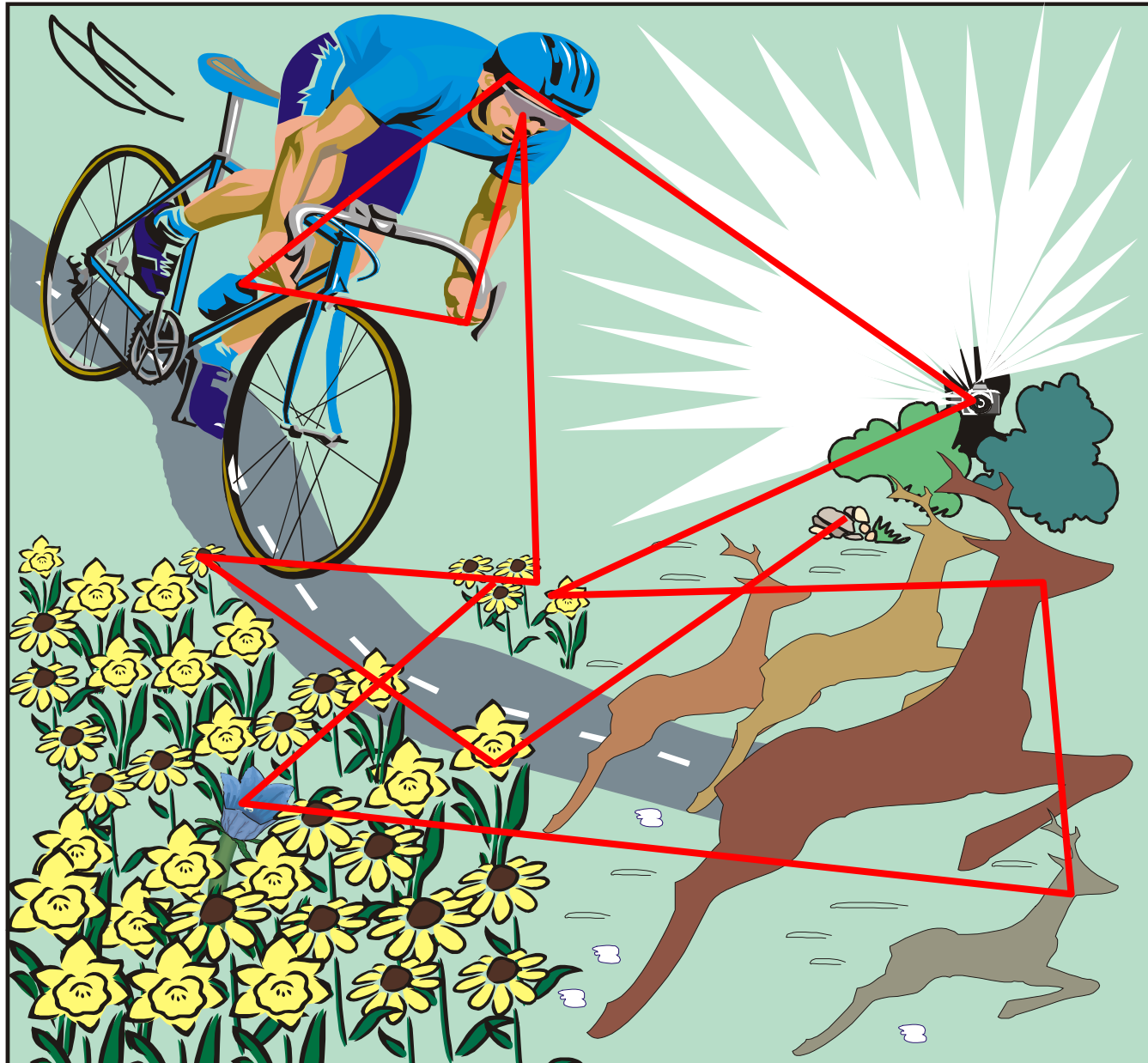
La vision centrale



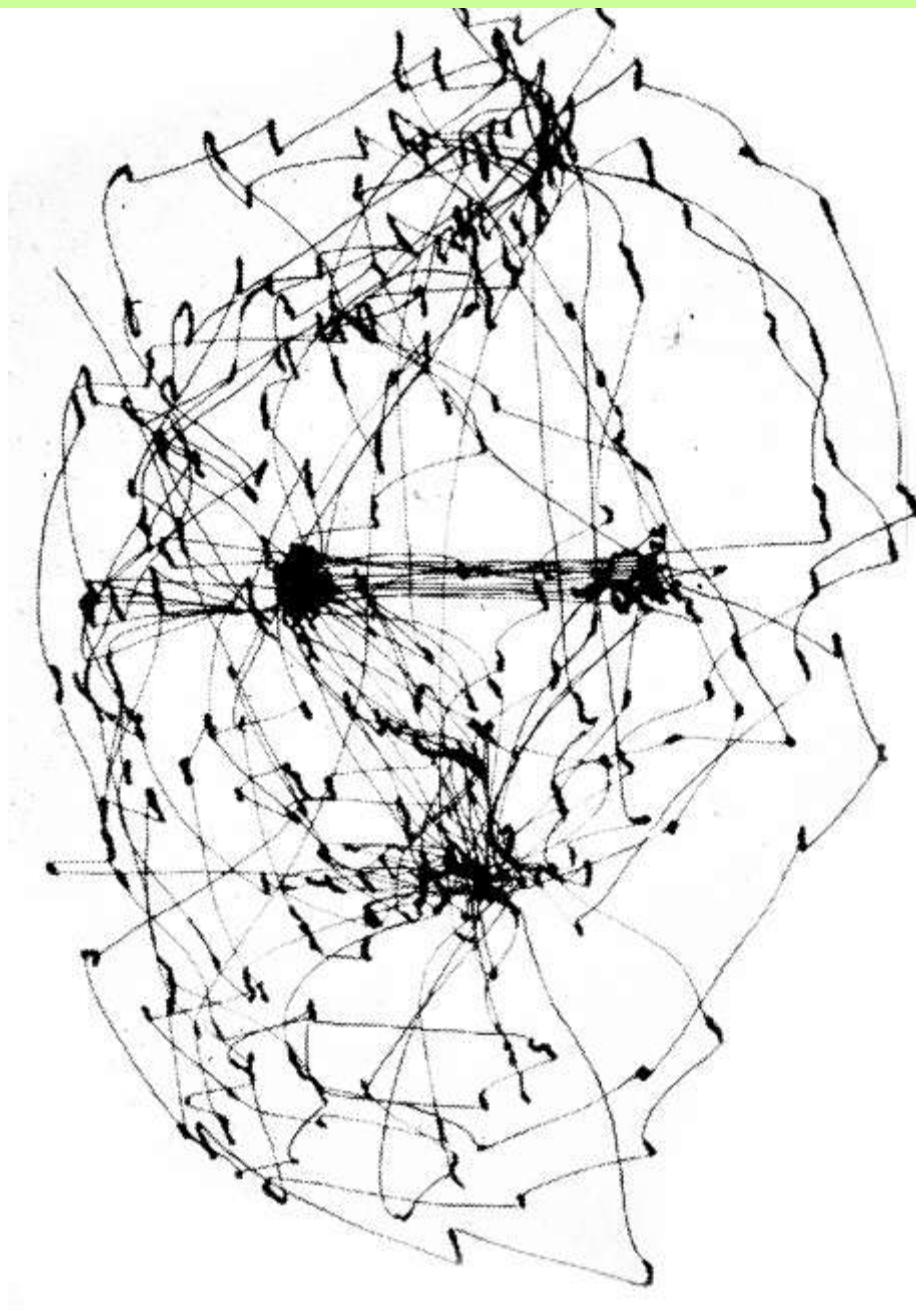
La vision centrale



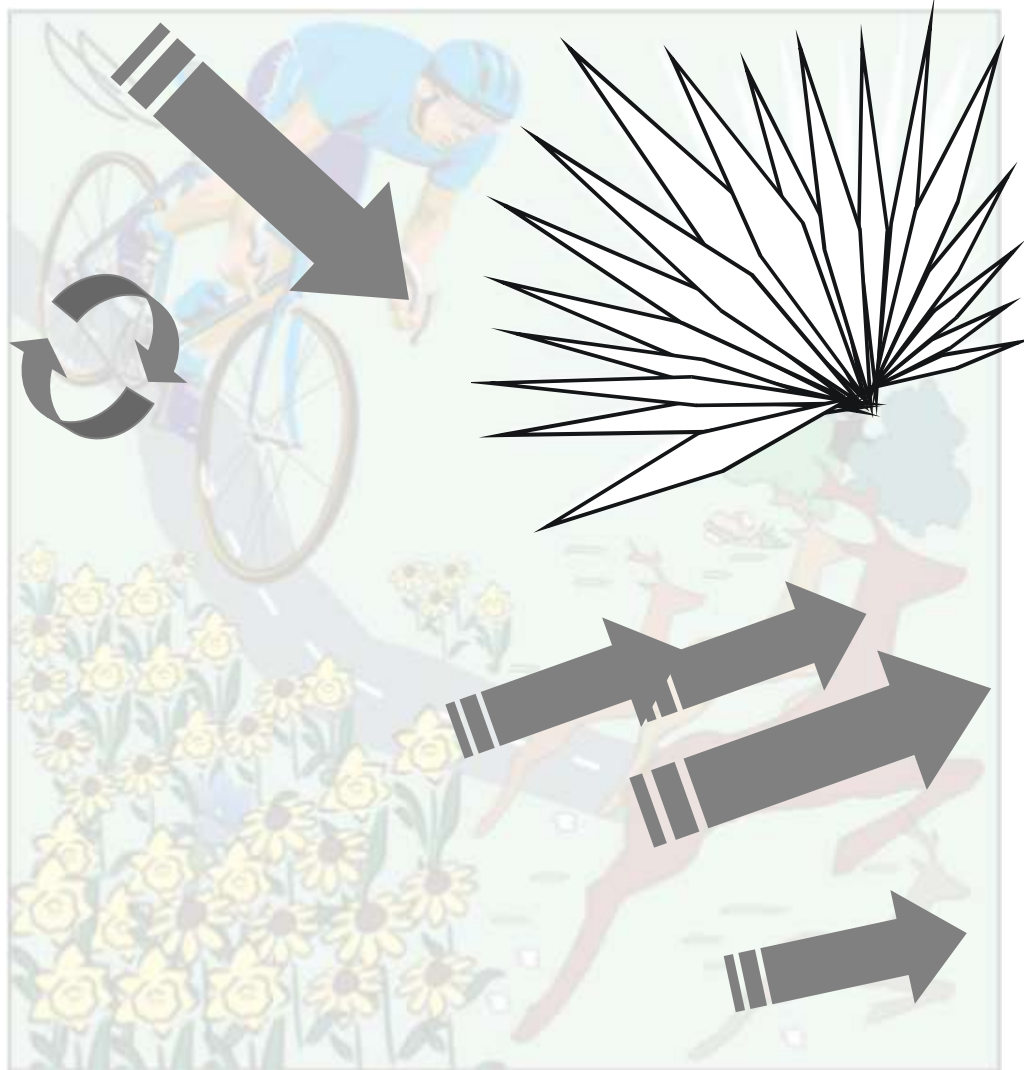
La vision centrale



La vision centrale

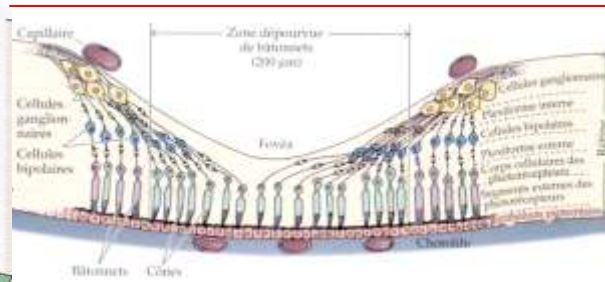
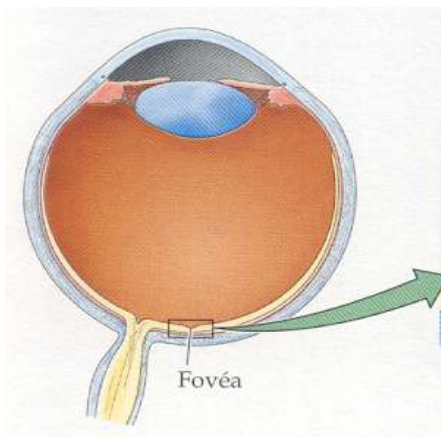
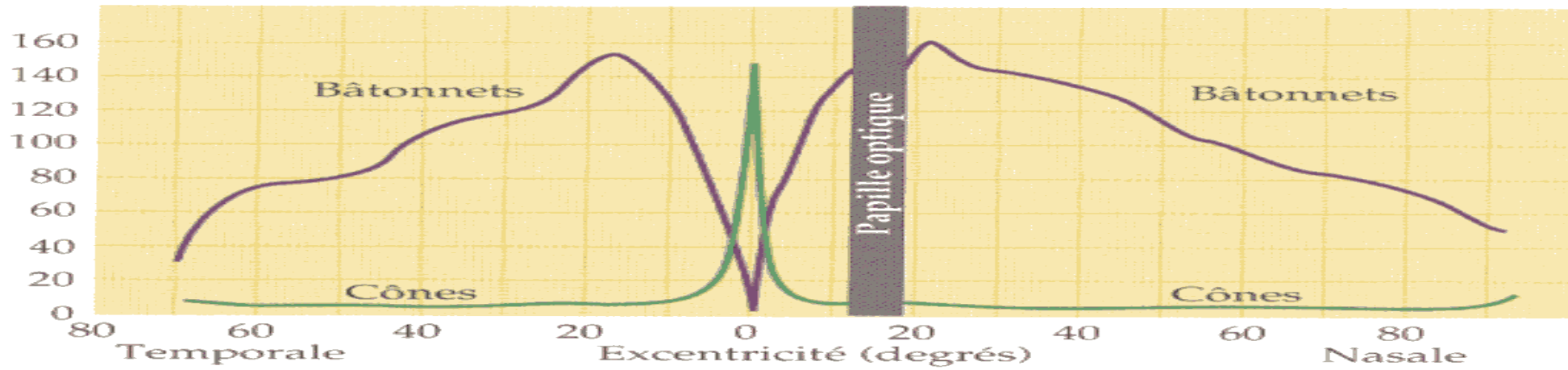


La vision périphérique



2. LA RETINE

Densité des récepteurs ($\text{mm}^{-2} \times 10^3$)

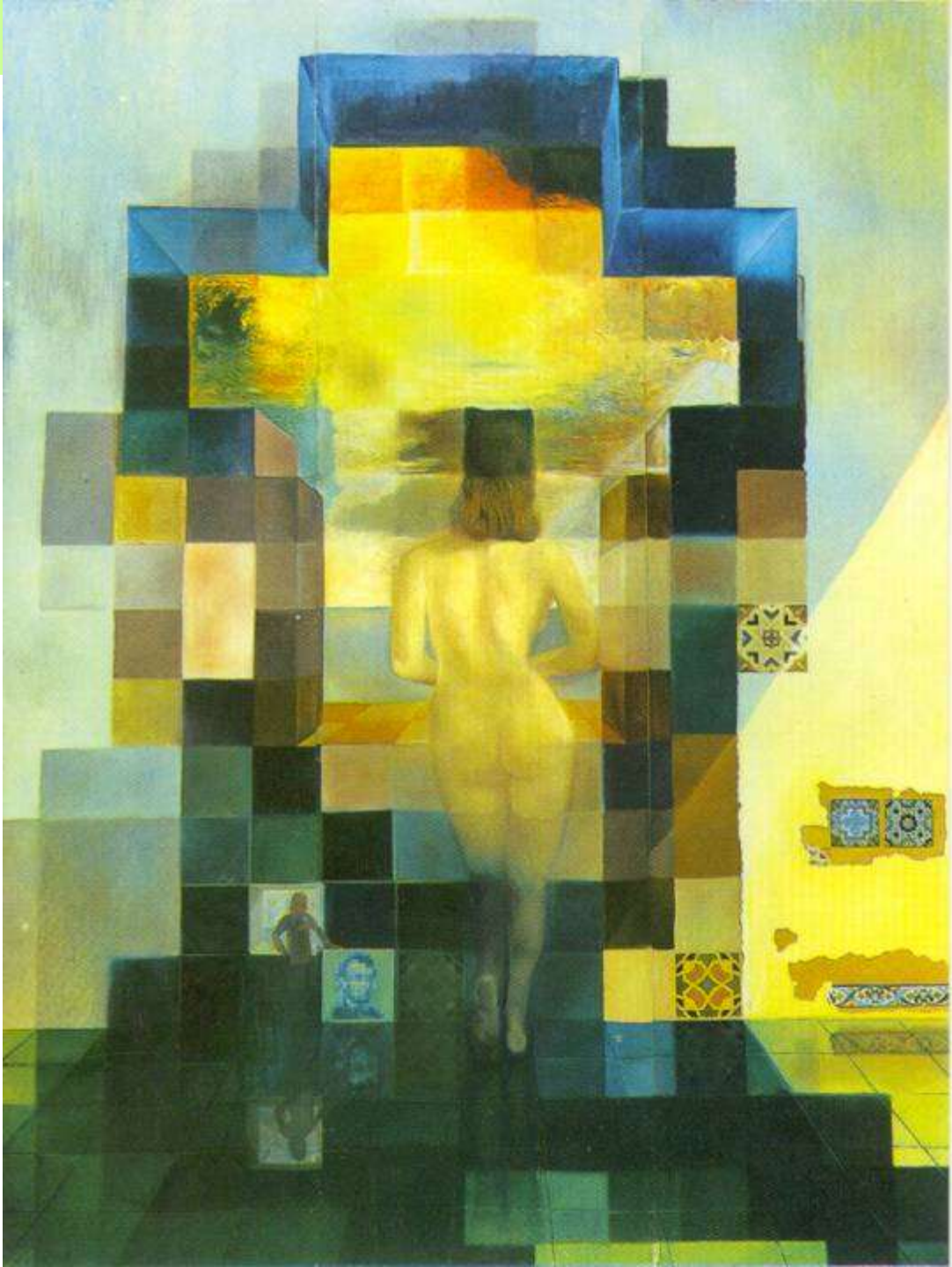


détails
couleurs

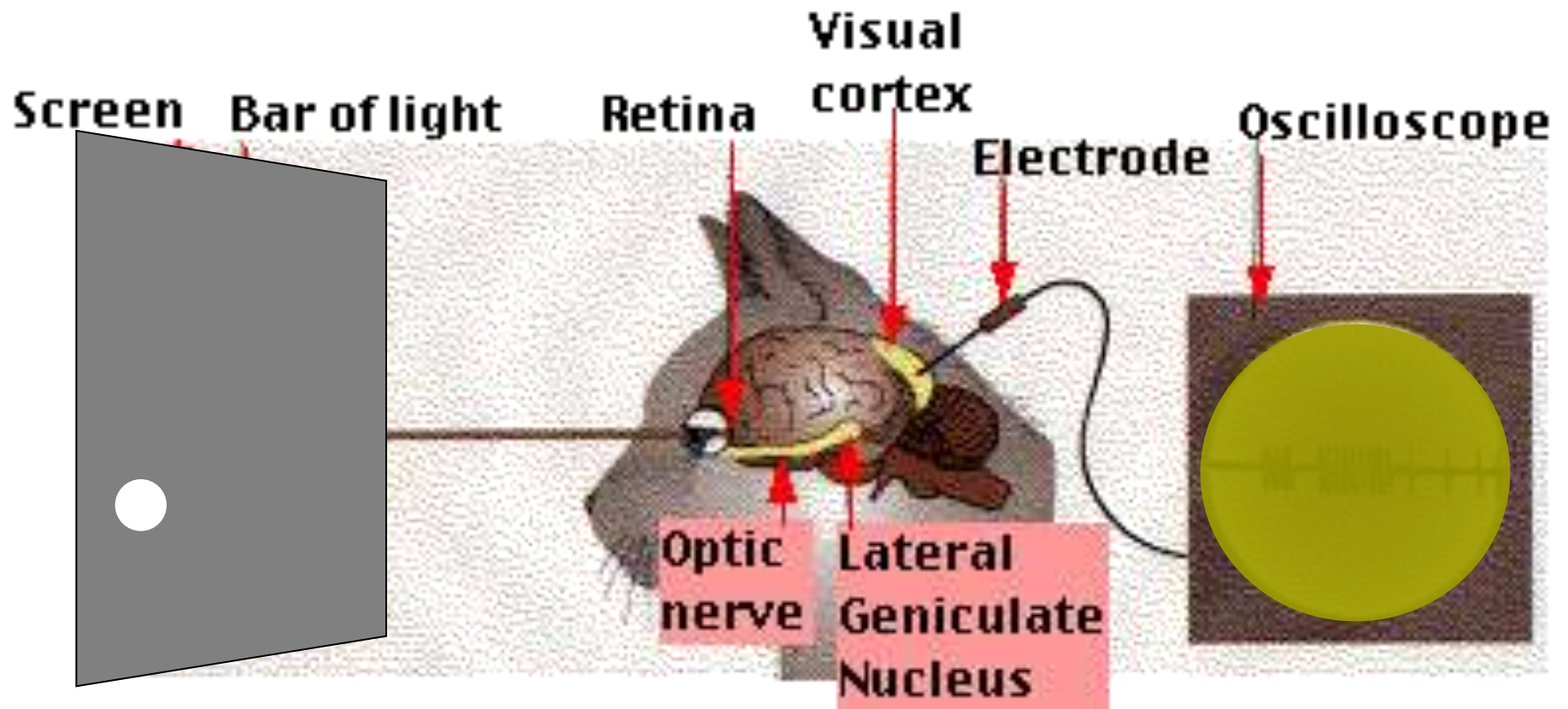
pénombre
mouvement

2. LA RETINE

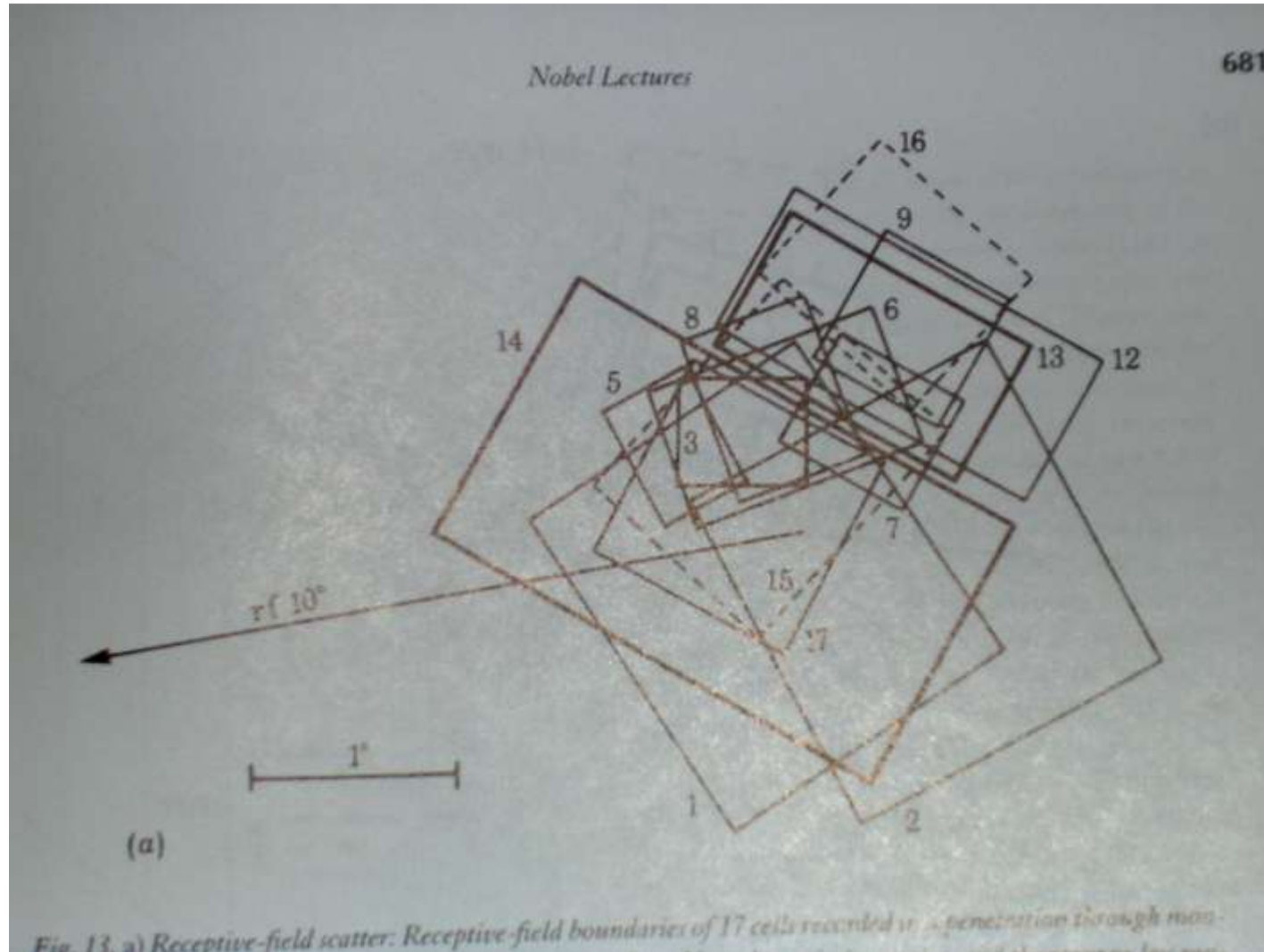
Vision focale
et
Vision ambiante



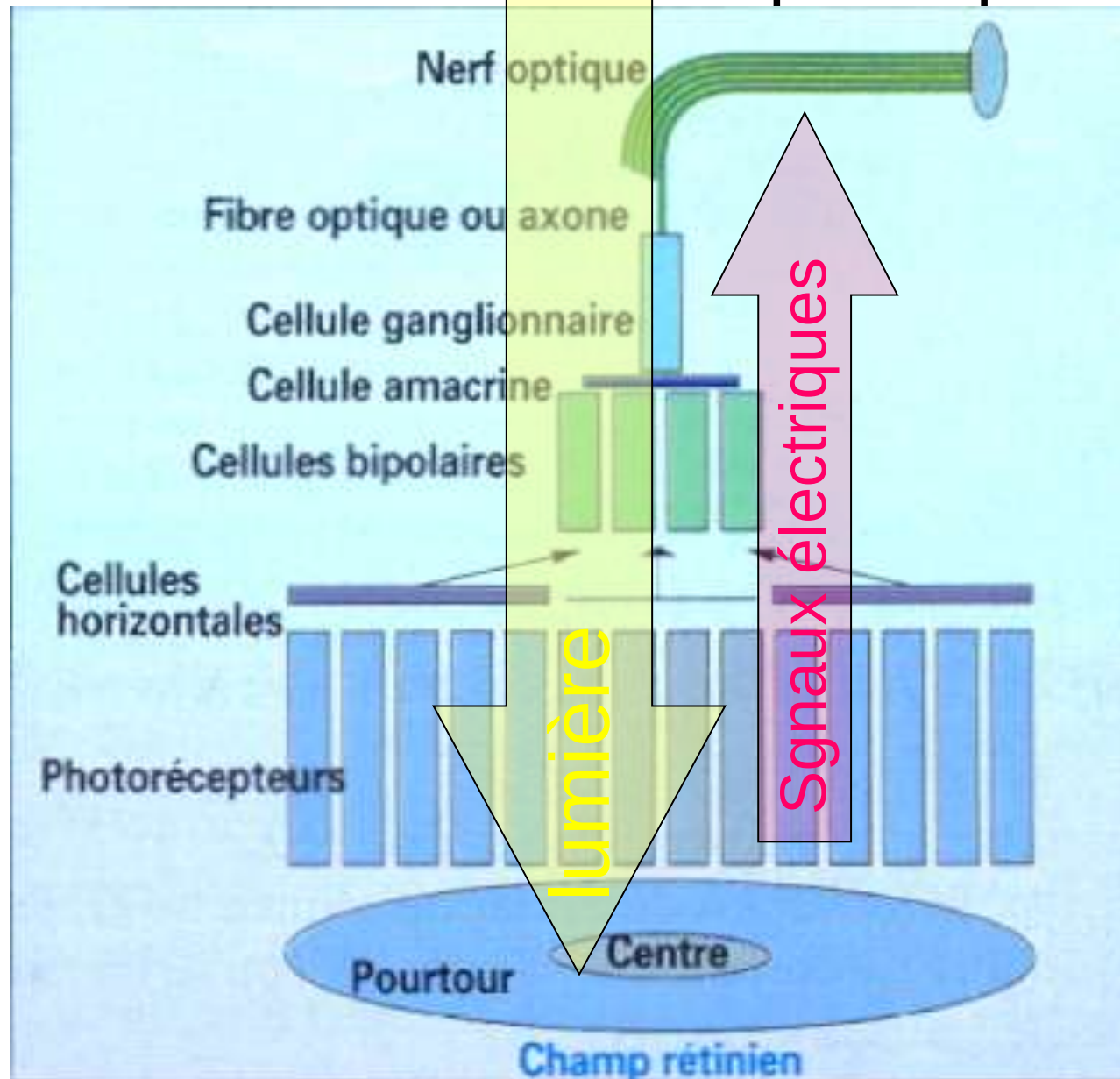
Champs récepteurs



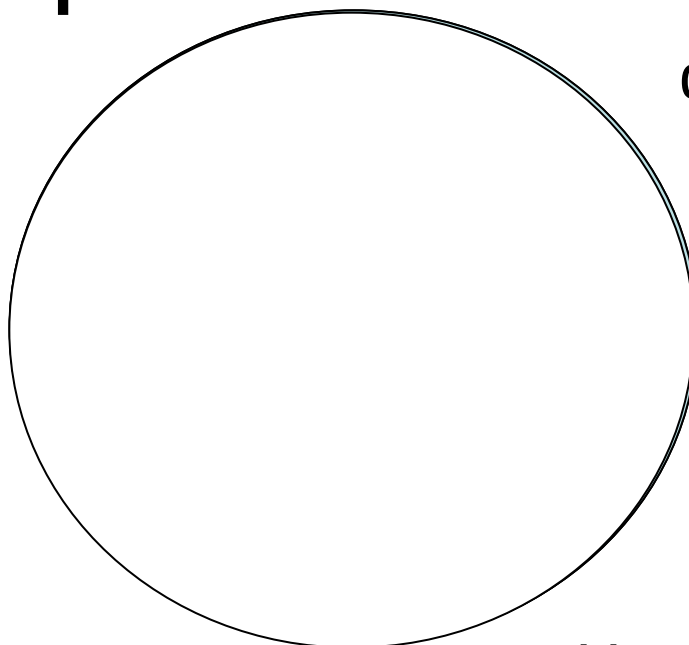
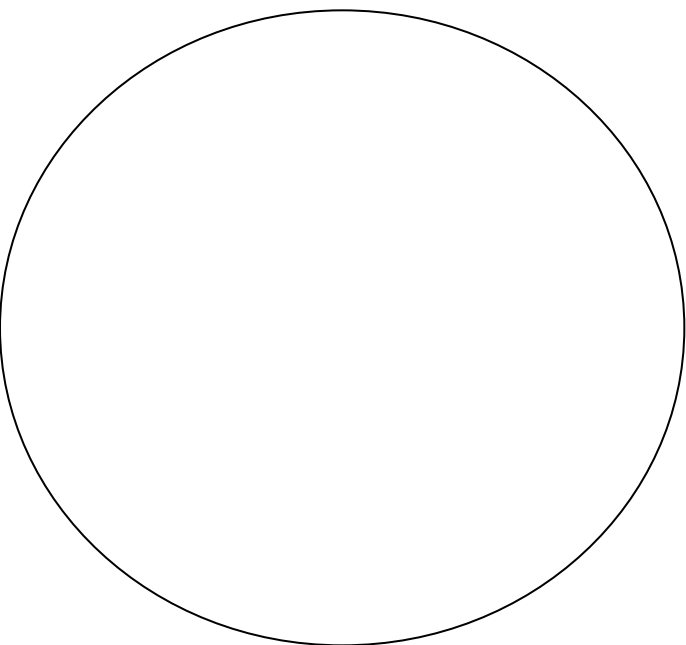
Champs recepteurs



Construction d'un champ récepteur



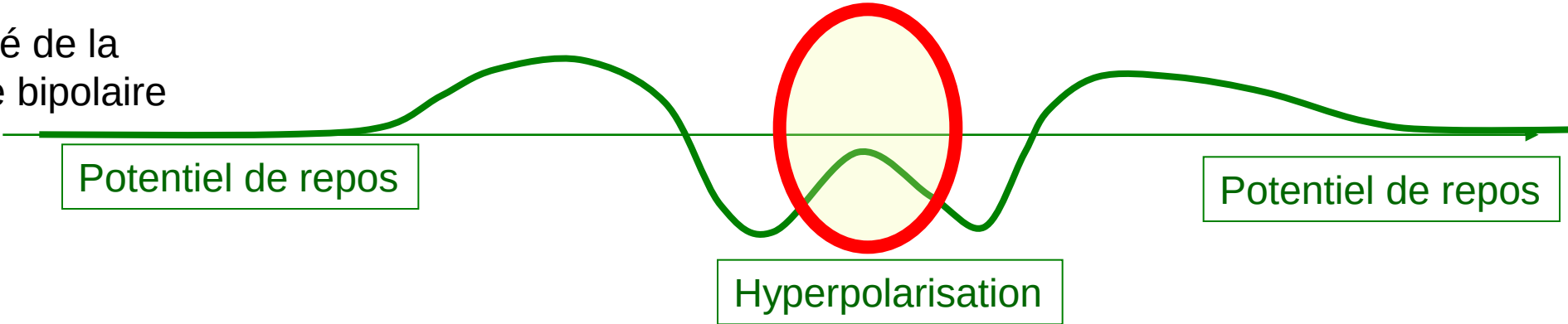
Cellule bipolaire



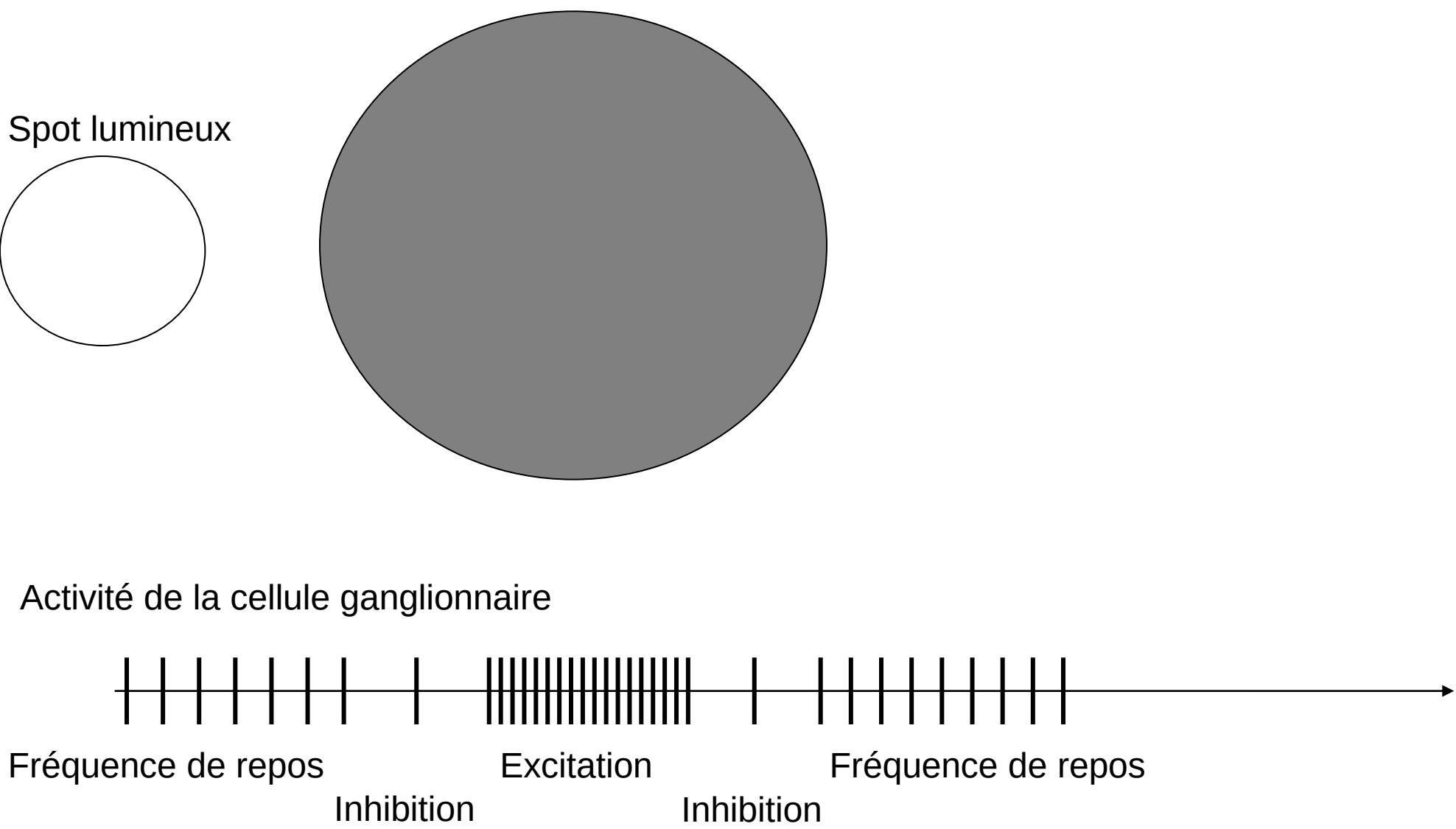
Zone D:
dépolarisation

Zone H:
Hyperpolarisation

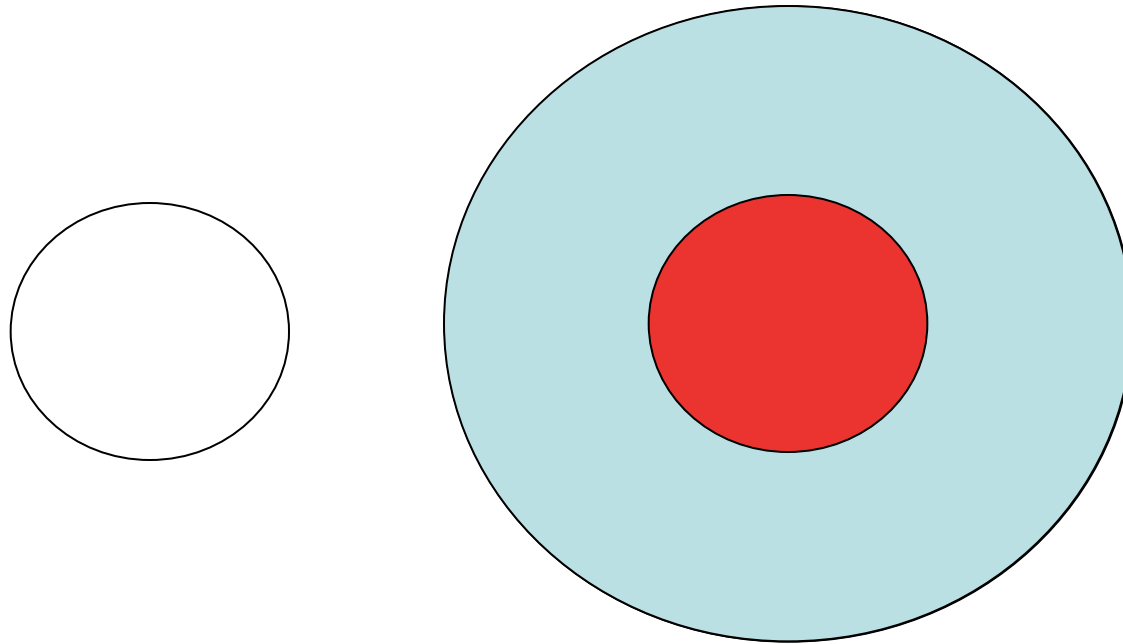
Activité de la
cellule bipolaire



Champ récepteur: cellule ganglionnaire



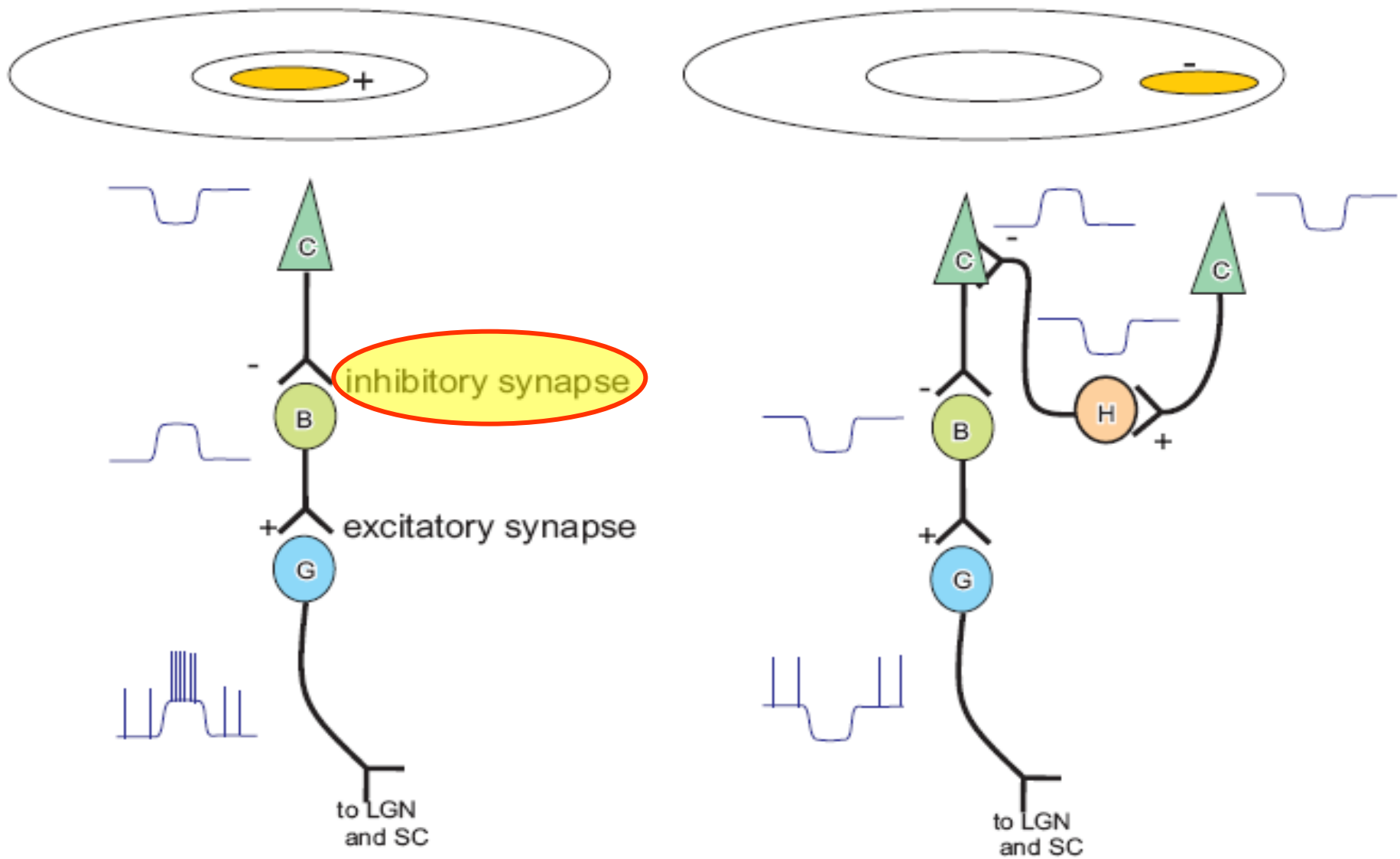
Cellule ganglionnaire



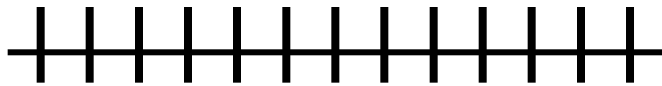
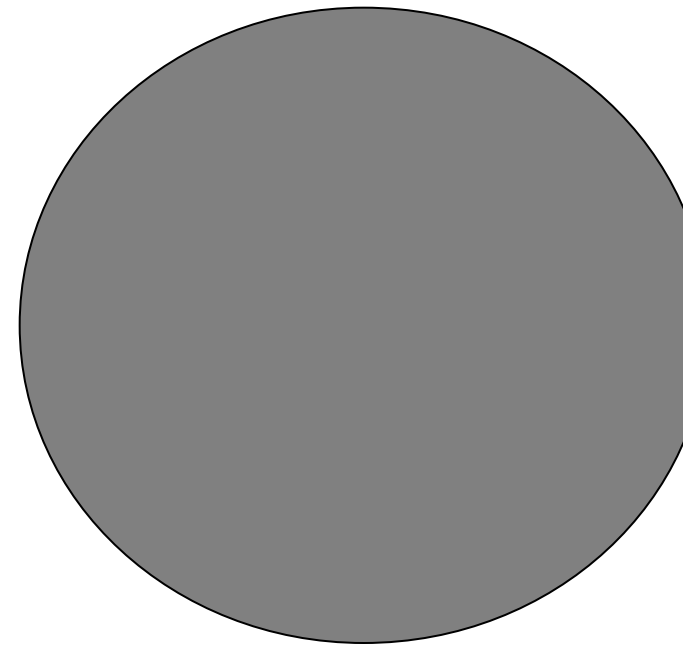
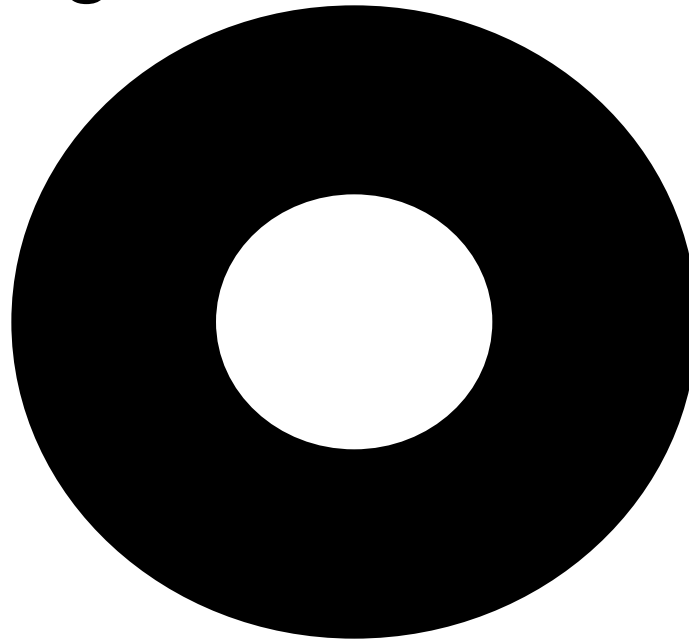
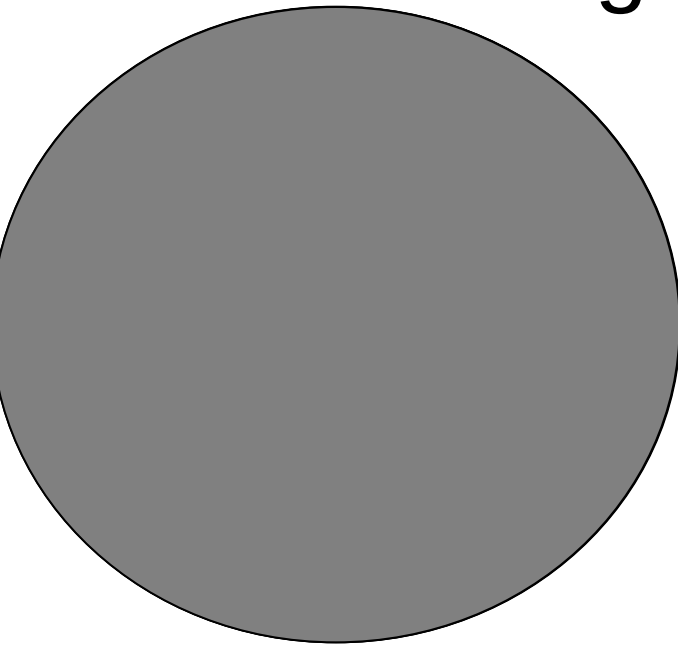
Zone D: zone ON

Zone H: zone OFF

Zone on et zone off



Cellule ganglionnaire: contraste temporel

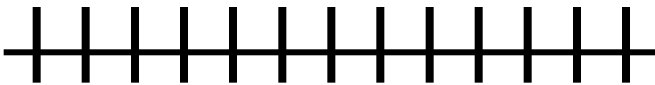
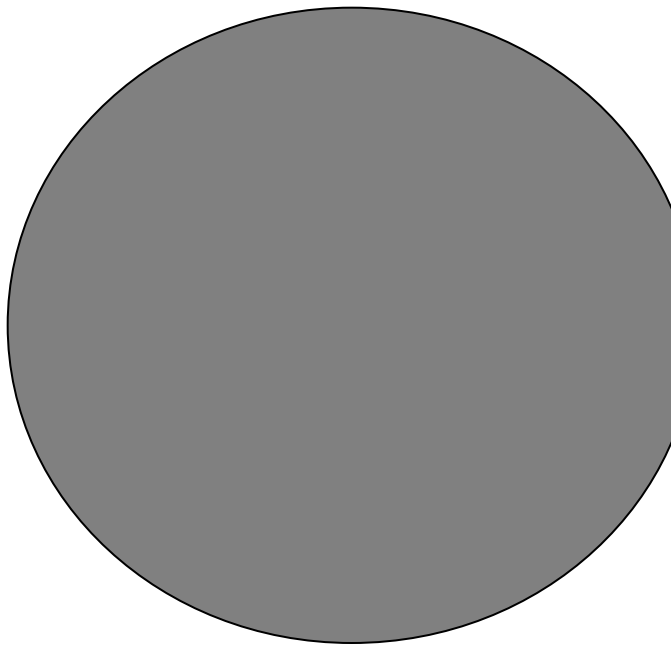
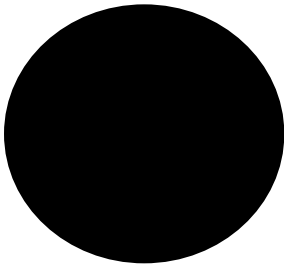
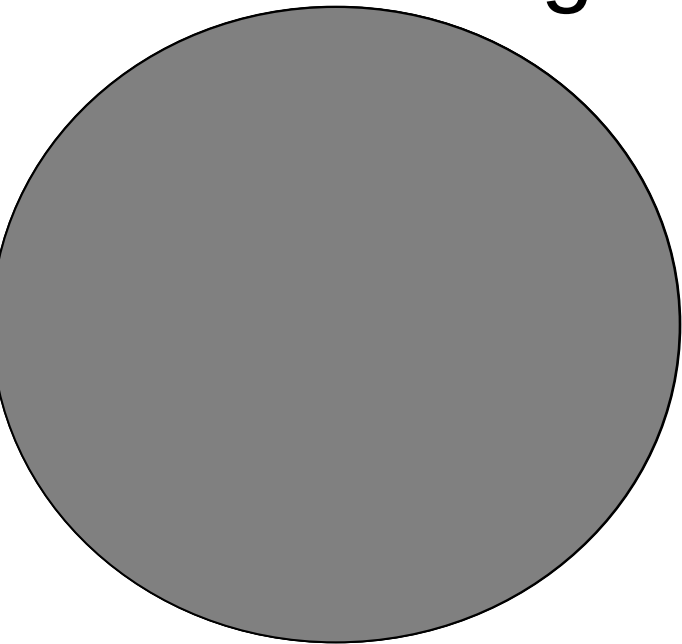


Fréquence de repos

Excitation

Inhibition
transitoire

Cellule ganglionnaire: Contraste temporel



Fréquence de repos

Inhibition

Excitation
transitoire

Cellules ganglionnaires



Deux grands types de cellules ganglionnaires

Magnocellulaire:

Résolution spatiale -

Résolution temporelle ++

Sensibilité au contraste +

Rapide

Parvocellulaire:

Résolution spatiale ++

Résolution temporelle -

Sensibilité à la couleur ++

Lent

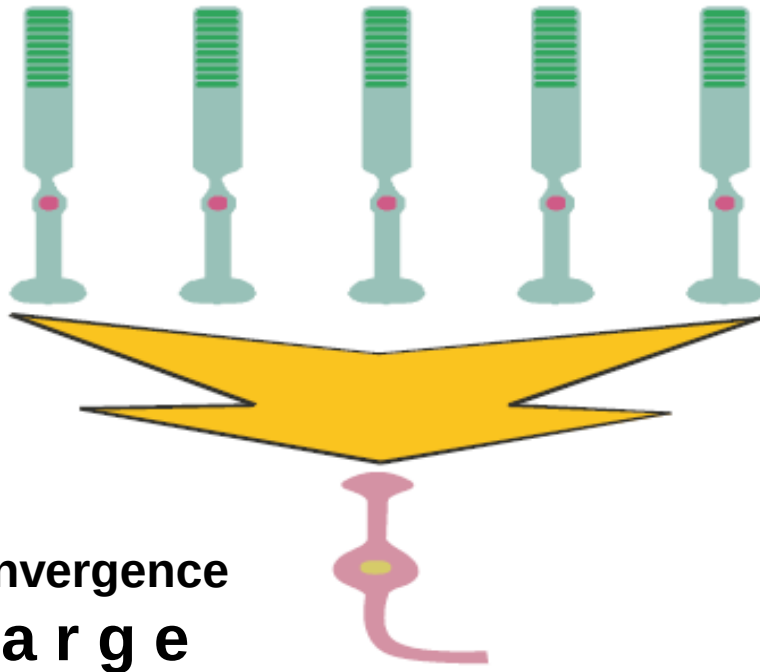
2. LA RETINE



2. LA RETINE

Pourquoi le système des cônes a t'il une meilleure acuité visuelle?

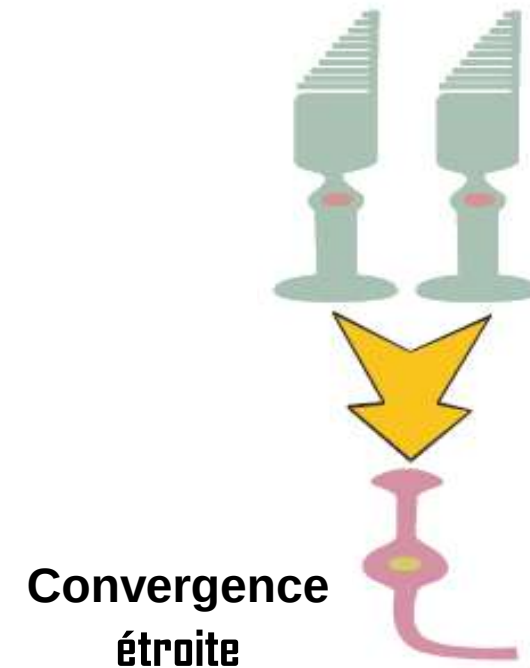
Bâtonnets (périphérie): espacés
=> **Faible densité**



La cellule ganglionnaire intègre l'information reçue par une large surface rétinienne: 3 deg

L'espacement et la convergence large sont responsables d'une faible acuité

Cônes (fovéa): nombreux
=> **Haute densité**



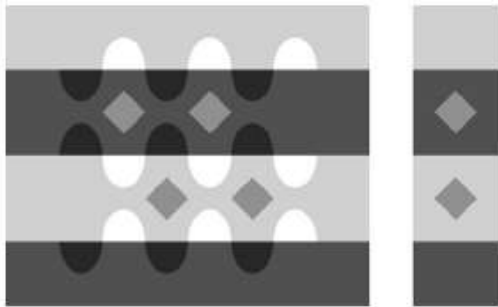
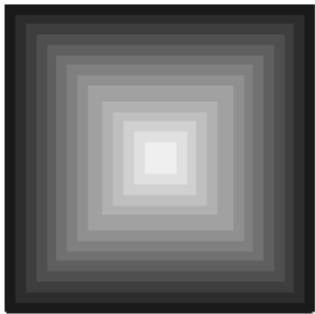
La cellule ganglionnaire intègre l'information reçue par une petite surface rétinienne: 0,03 deg

La densité et la convergence faible sont responsables d'une bonne acuité

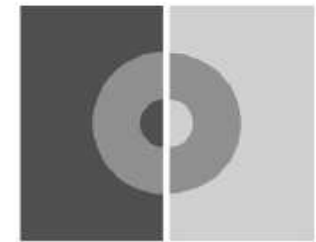
Contraste spatial







a

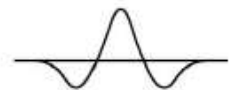


b

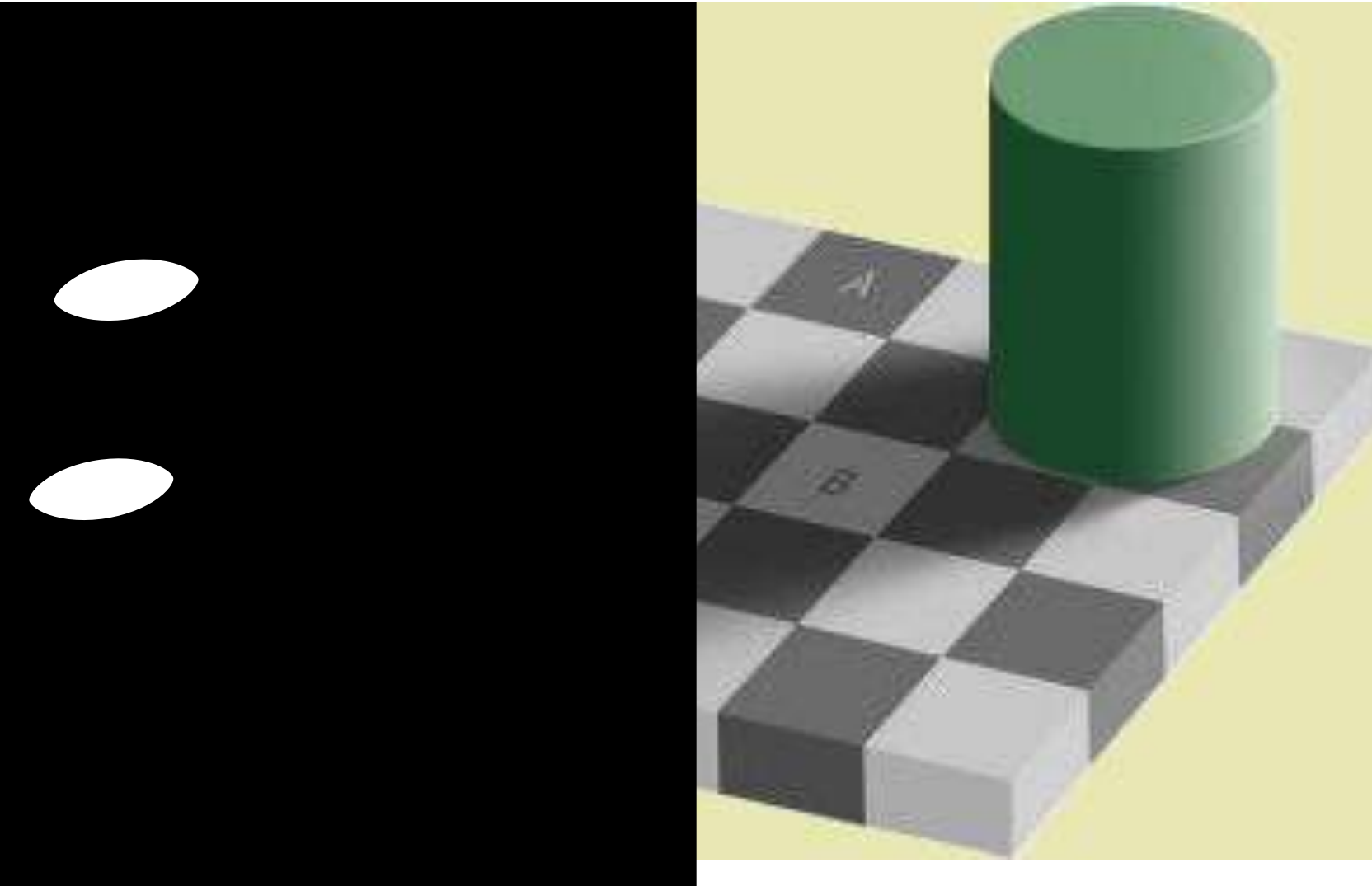


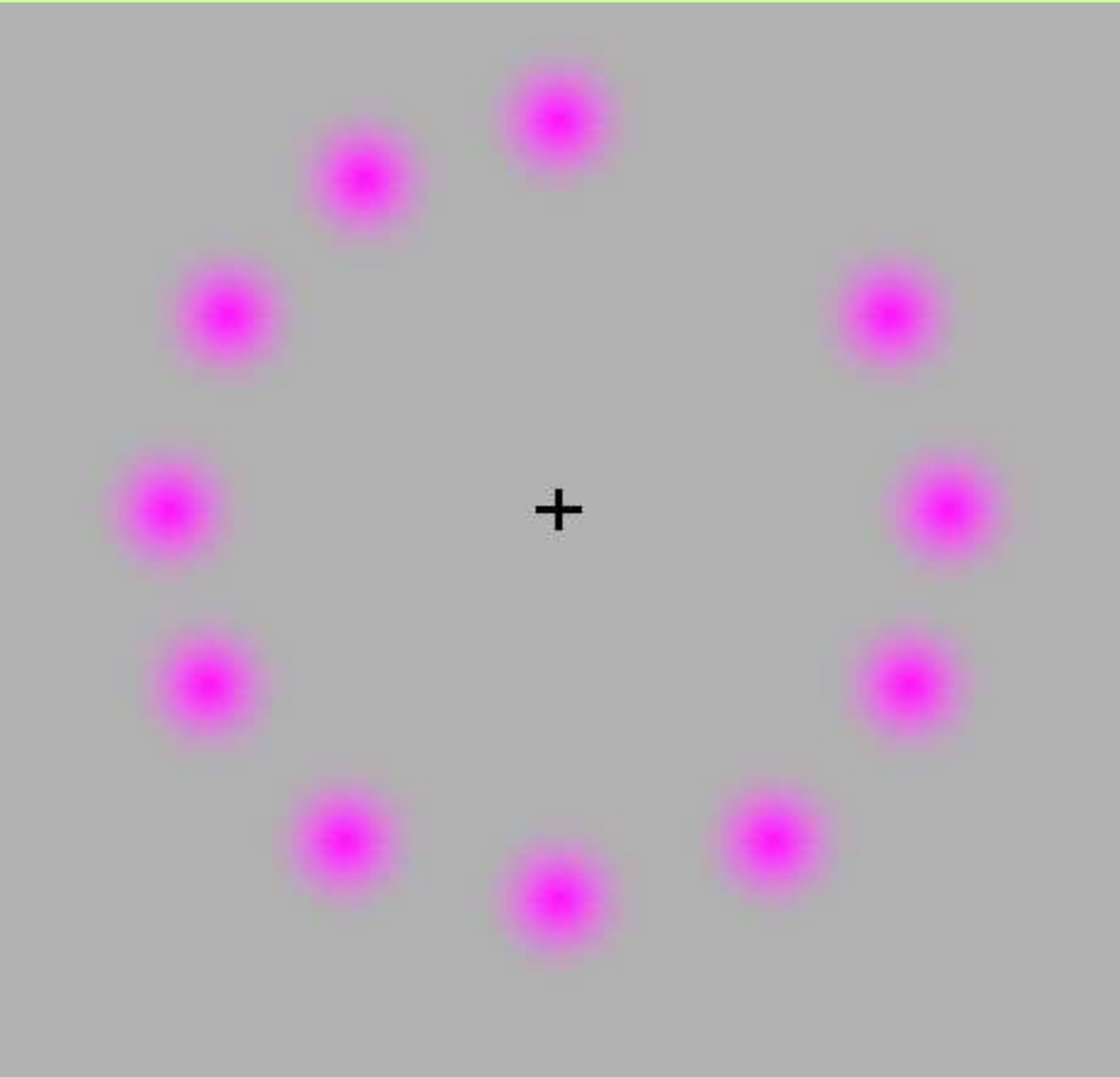
Varian

(a) The
uniform
half-rin
differe
two ha



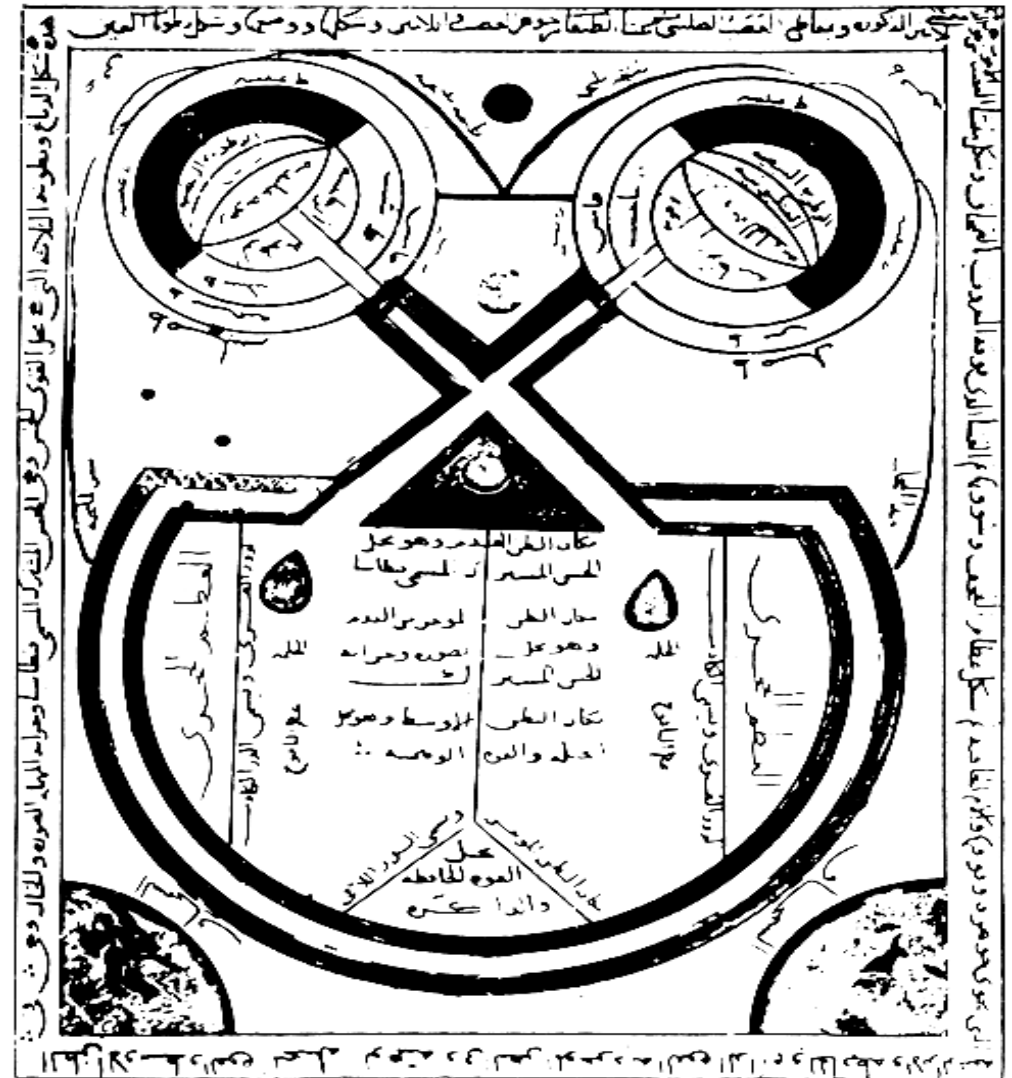
Codage par contraste



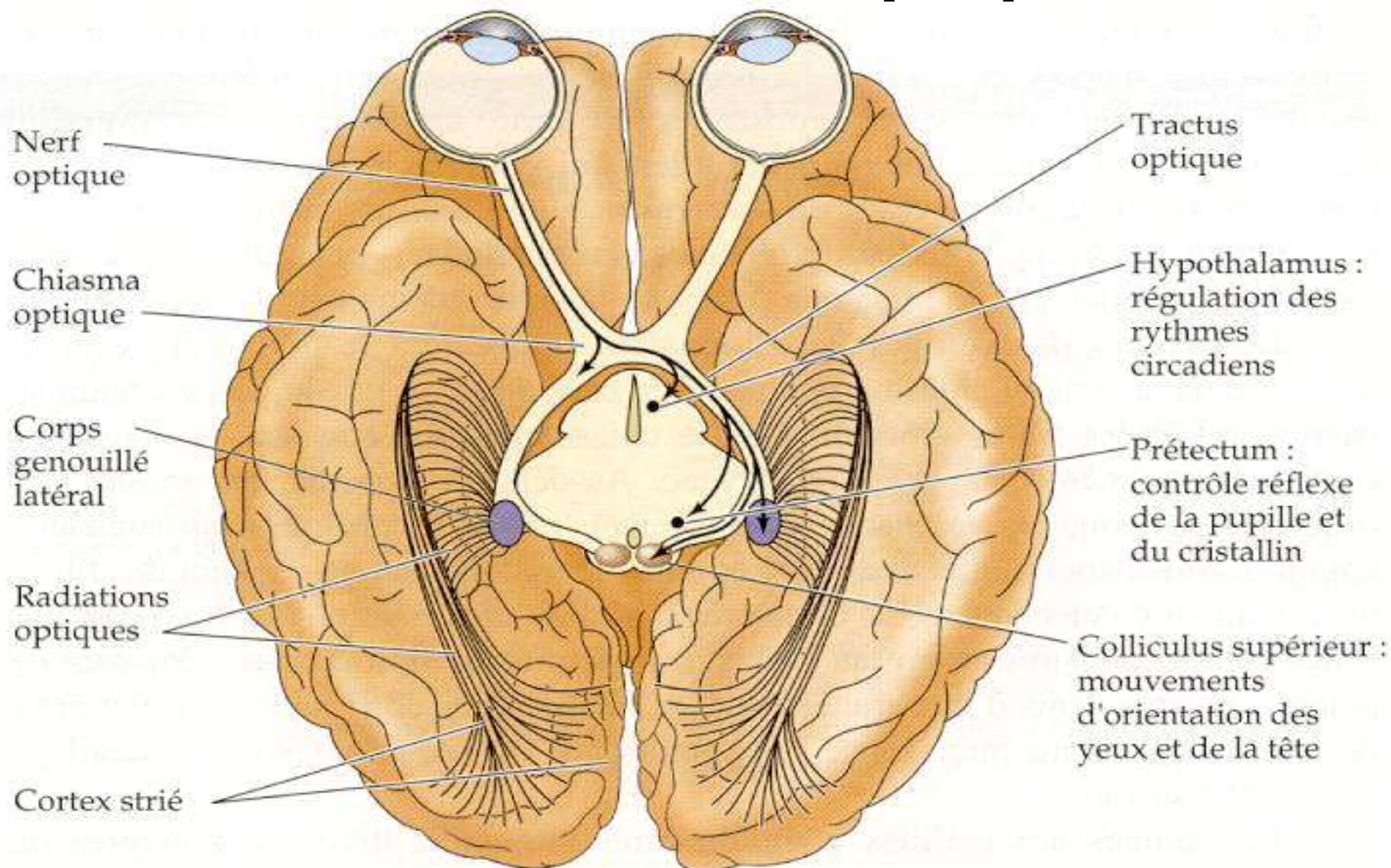


3. Voies visuelles et optiques

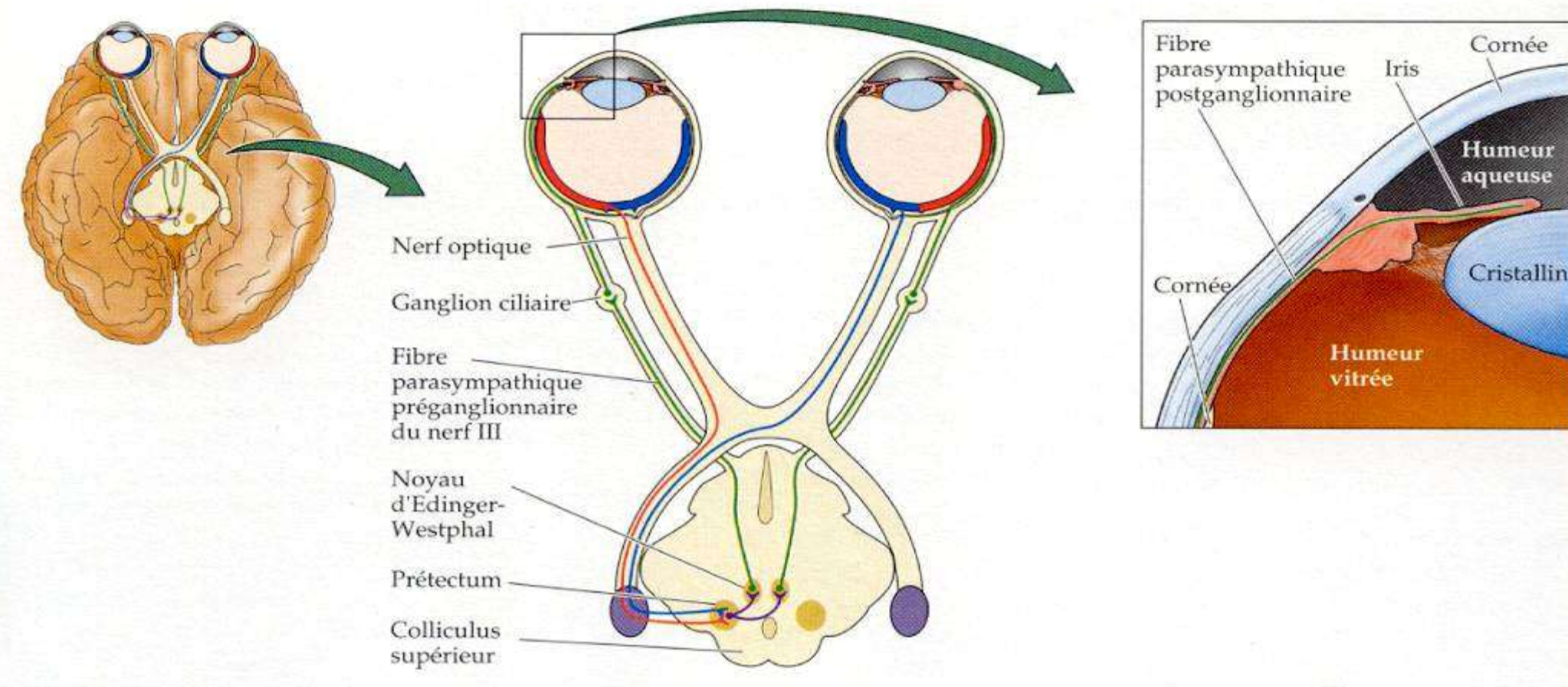
- Voies retino-géniculées
- Voies géniculo-striées
- Amputations du champs visuel



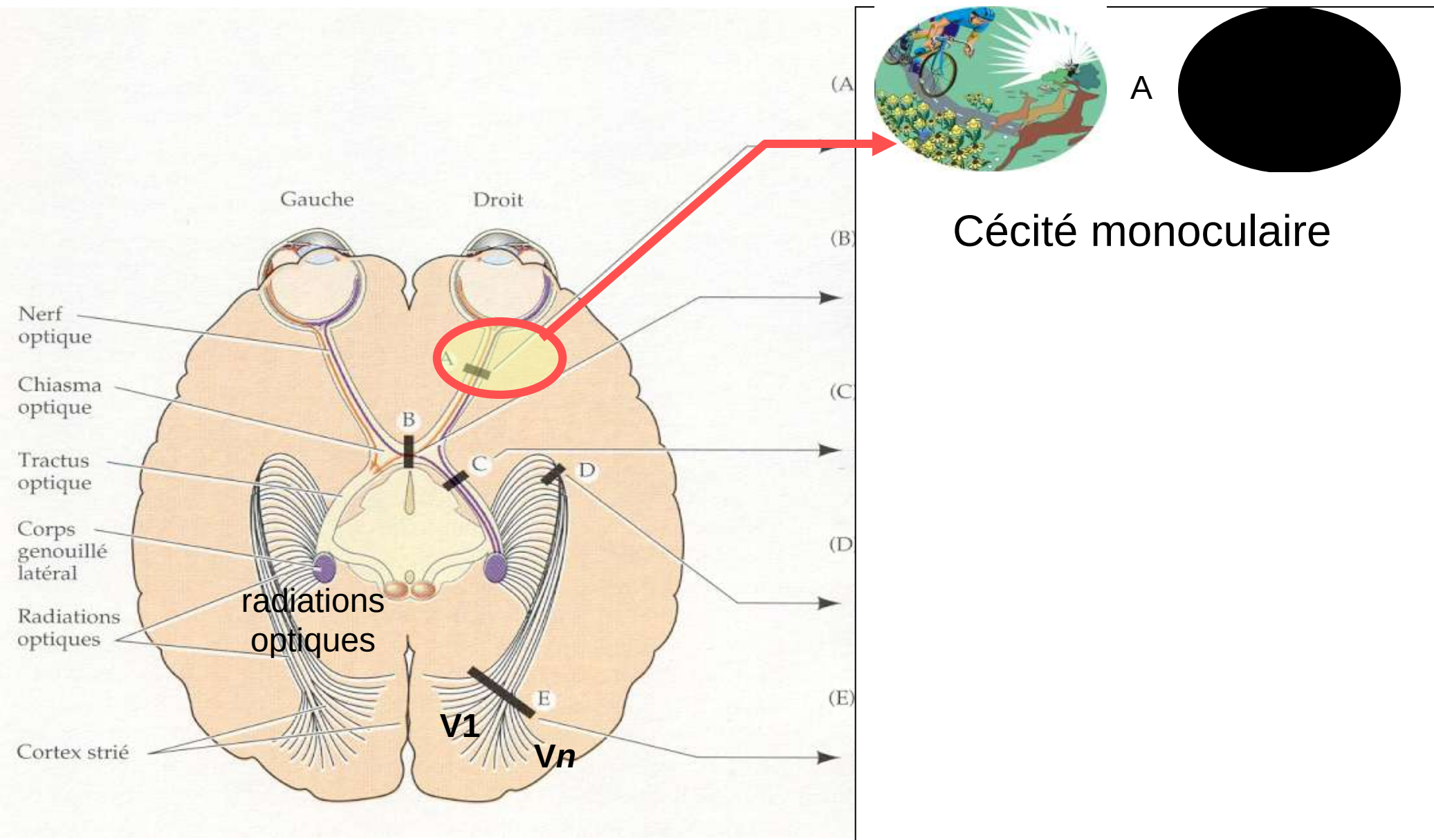
Voies visuelles et optiques



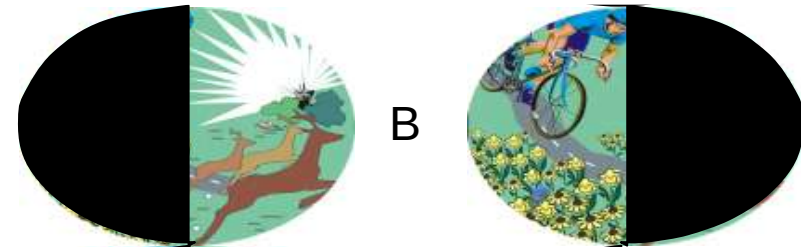
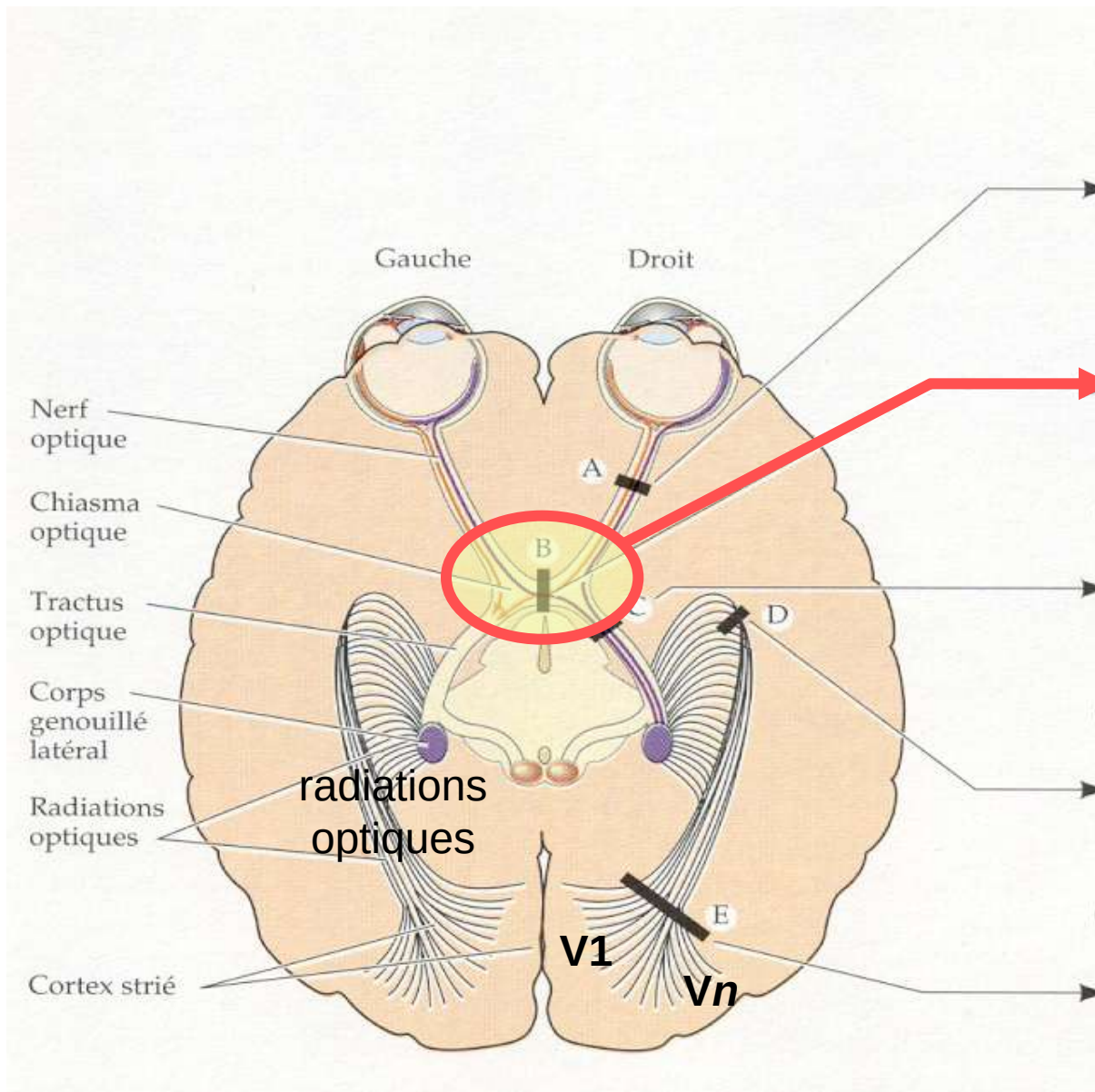
Réflexe pupillaire



Voies visuelles et amputations du champ visuel

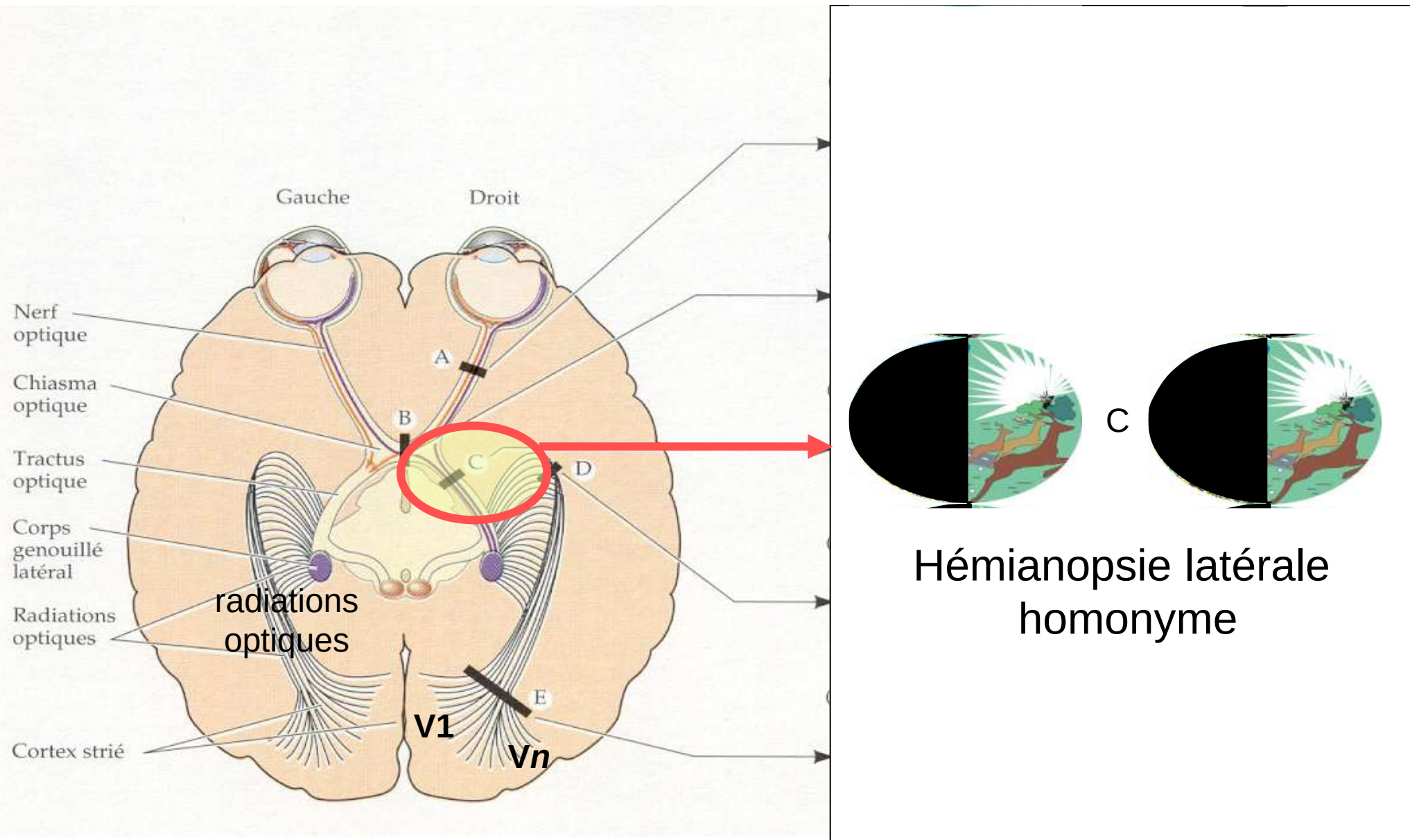


Voies visuelles et amputations du champ visuel

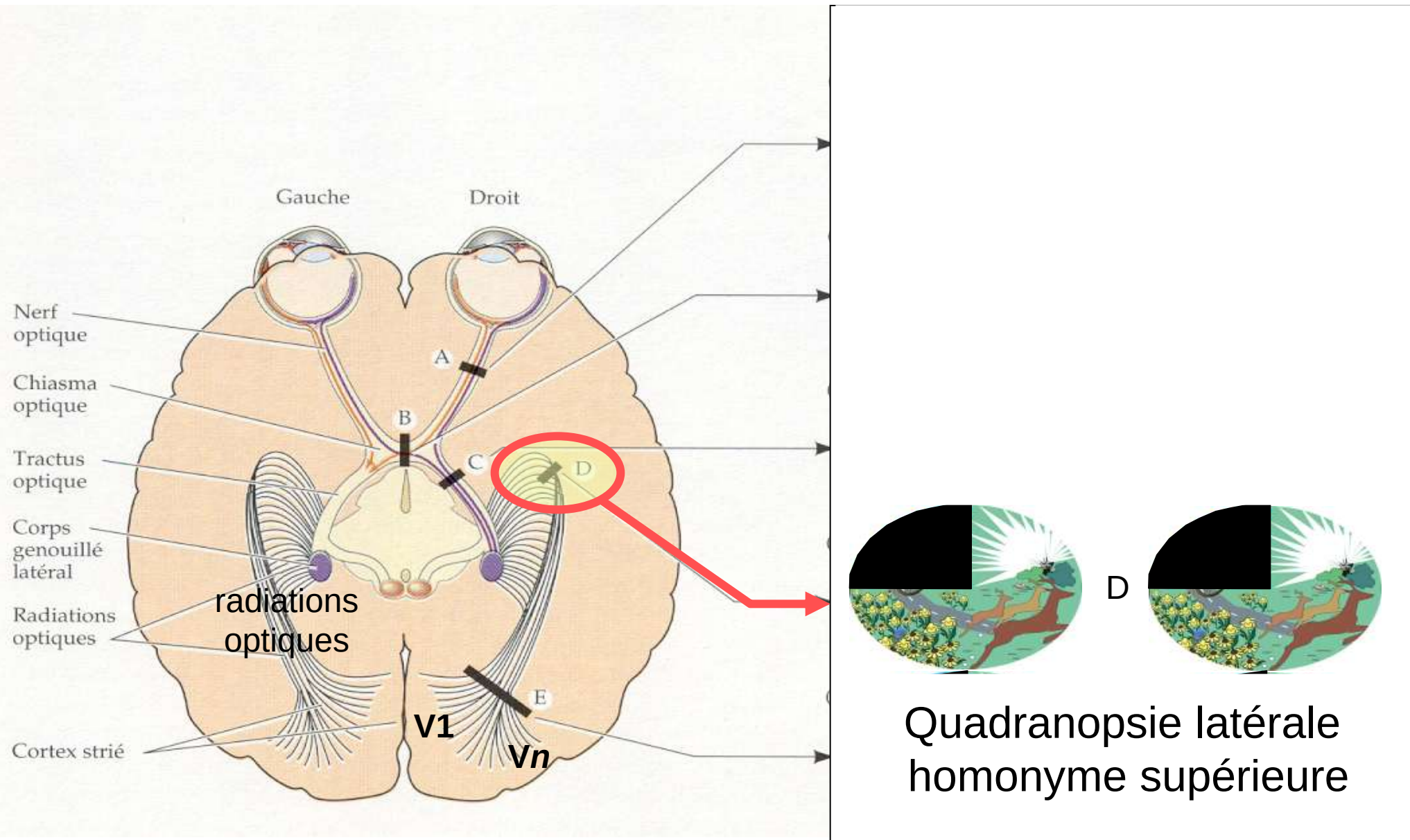


Hémianopsie bitemporale

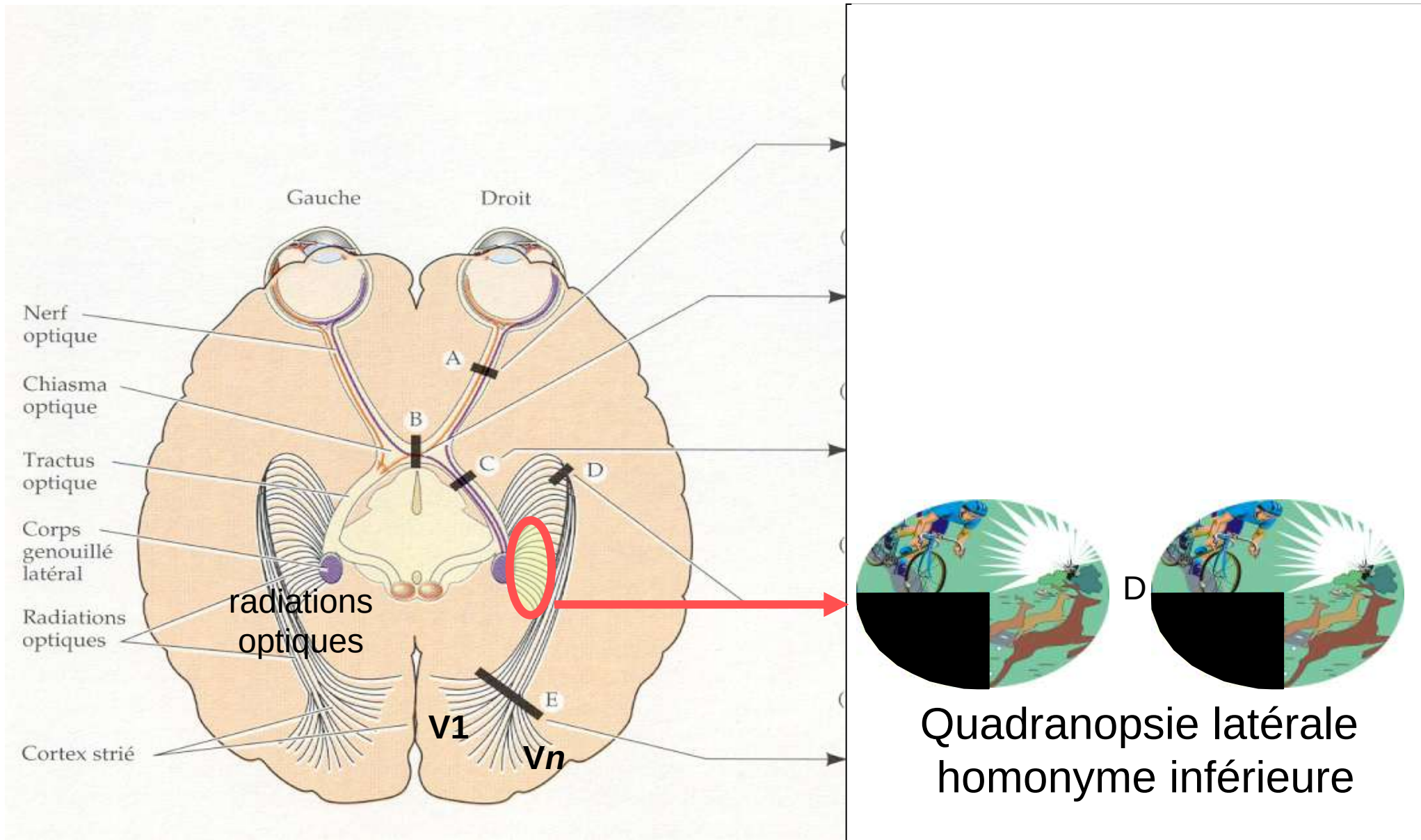
Voies visuelles et amputations du champ visuel



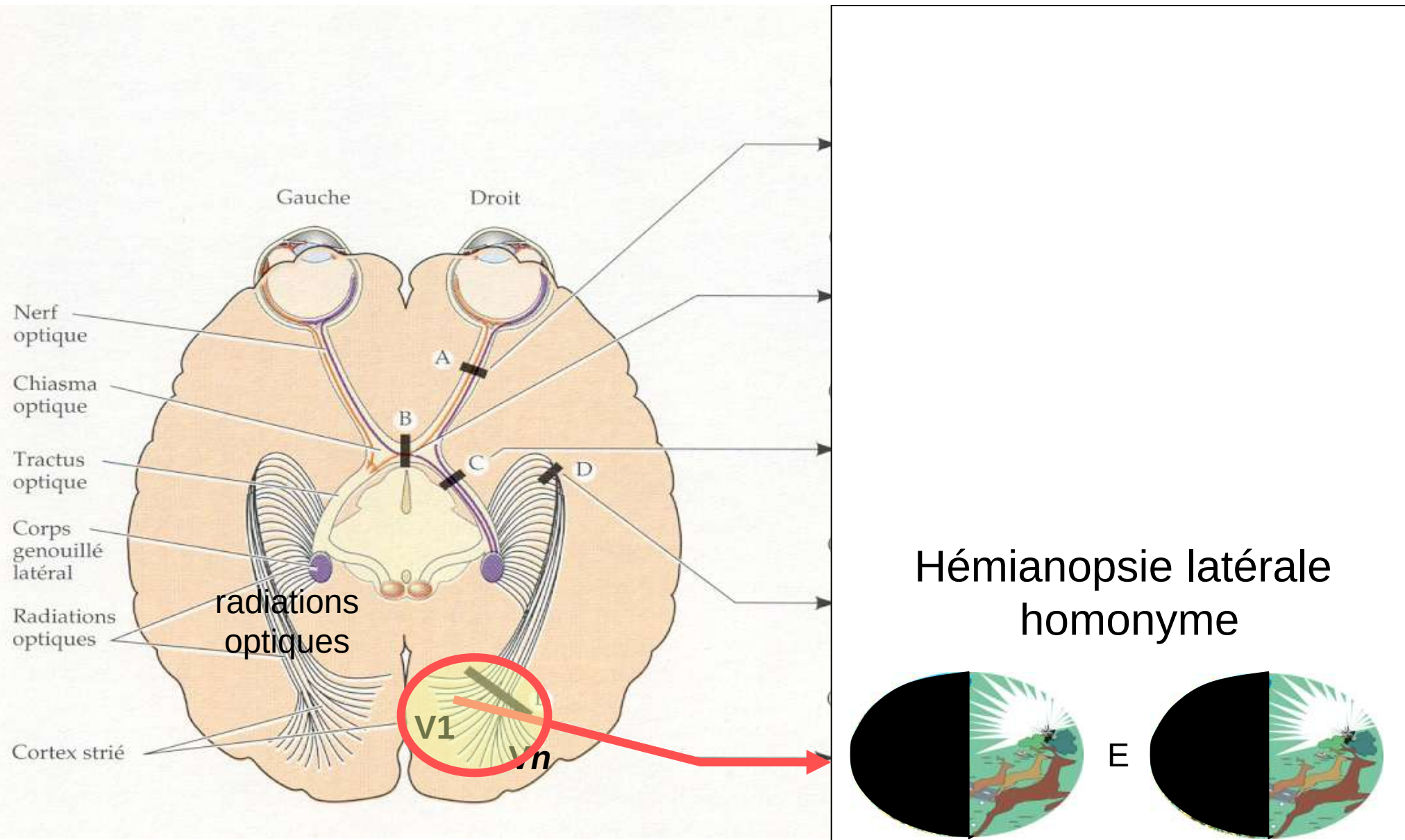
Voies visuelles et amputations du champ visuel



Voies visuelles et amputations du champ visuel



Voies visuelles et amputations du champ visuel



4. Entrées du cortex visuel primaire

4.1. Organisation des projections

4.2. Les neurones de V1

4.2.1. Au-delà de V1: ségrégation

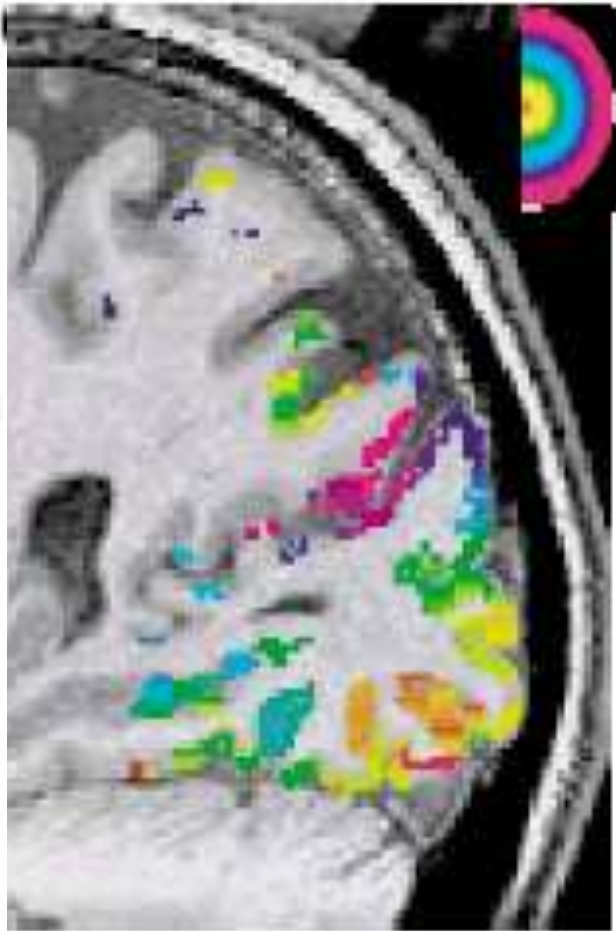
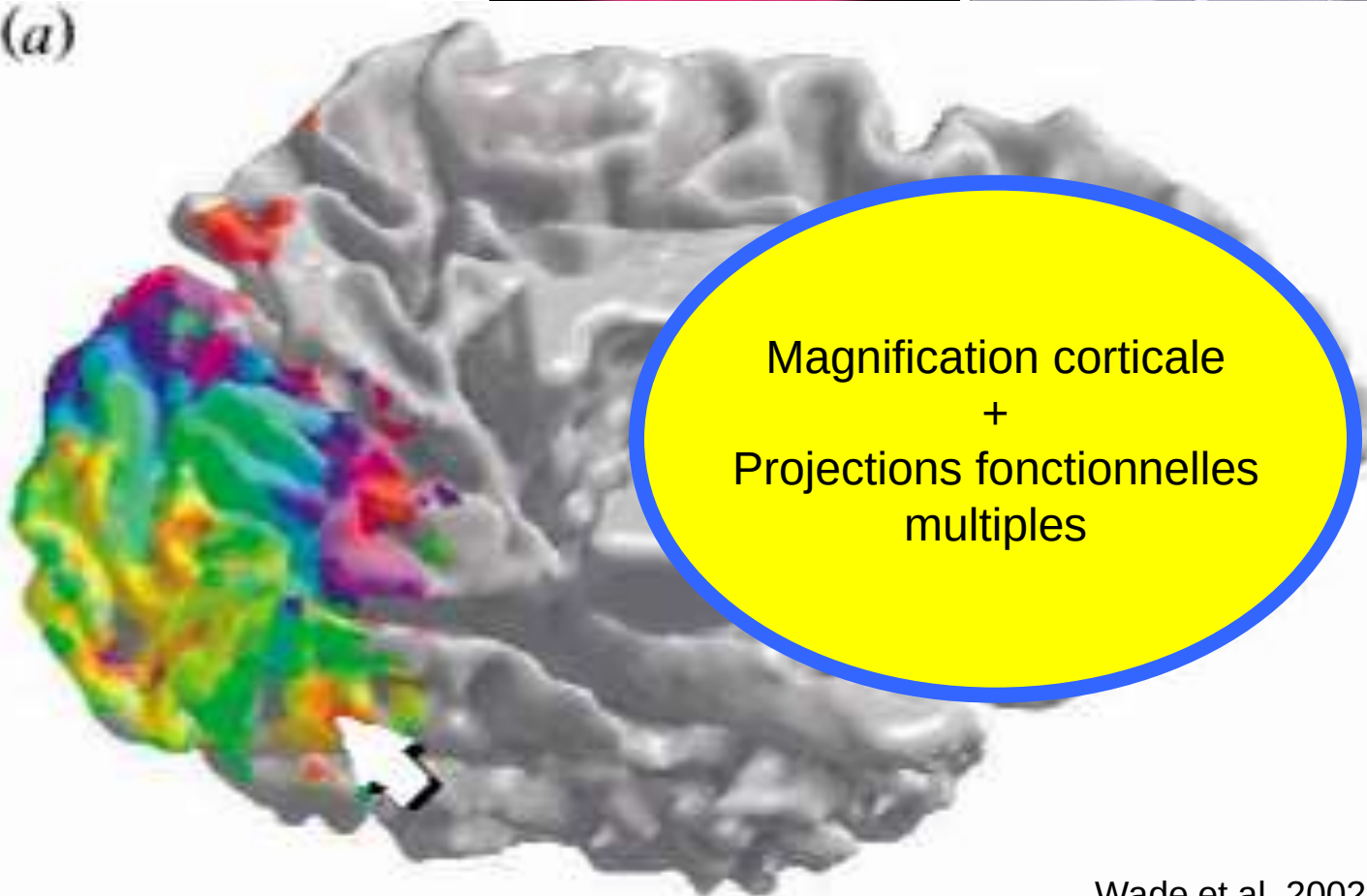
4.2.2. V2, V3, V4, V5, V6

4.3. Approche neuropsychologique

4.4. Deux voies corticales



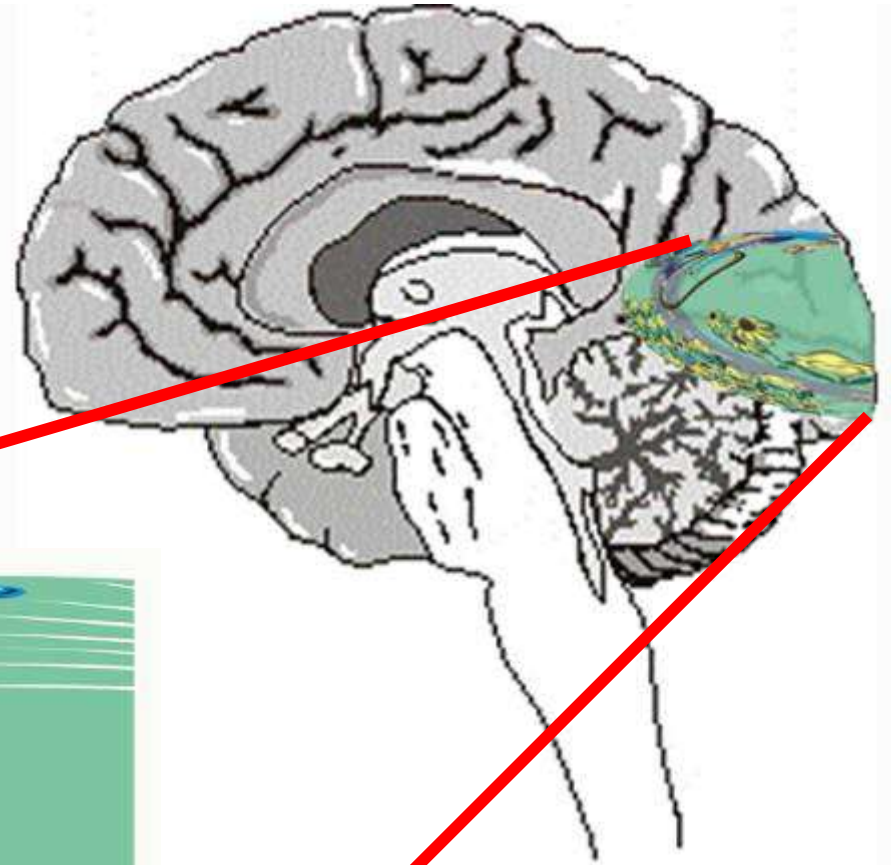
Projection corticale



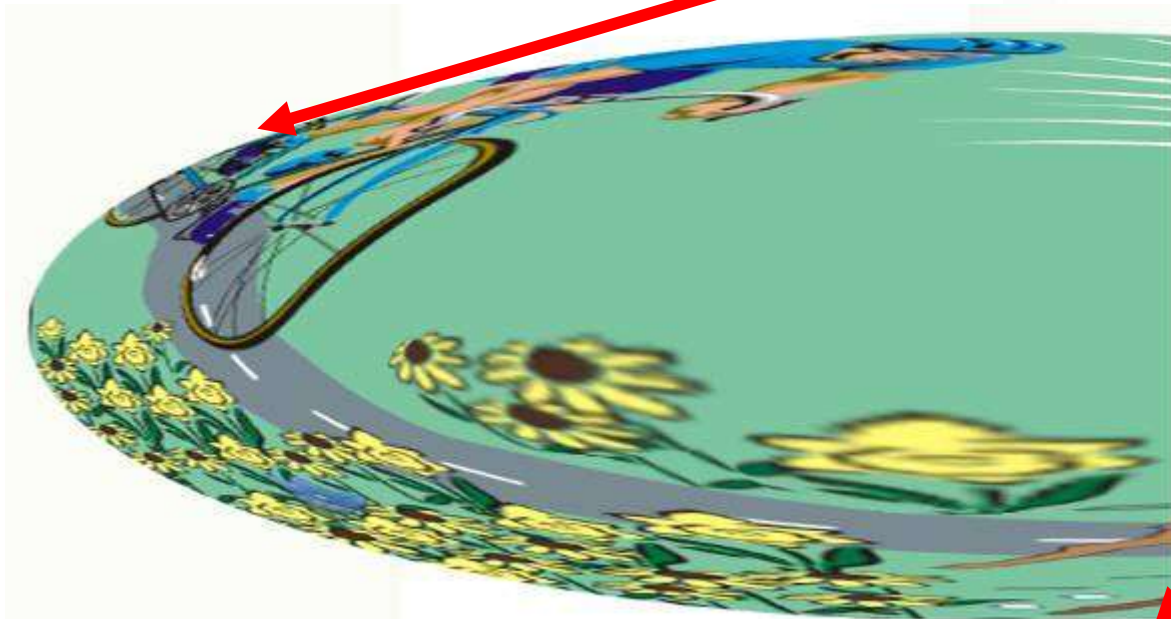
Magnification corticale



Hémichamp gauche



Cortex visuel droit



Neurones de V1

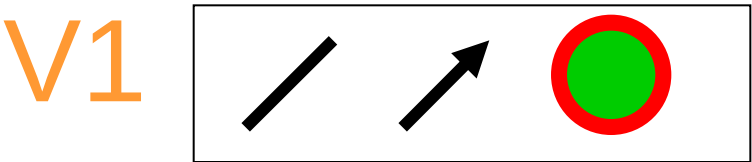
Orientation

Direction du mouvement

Disparité rétinienne (binoculaires)

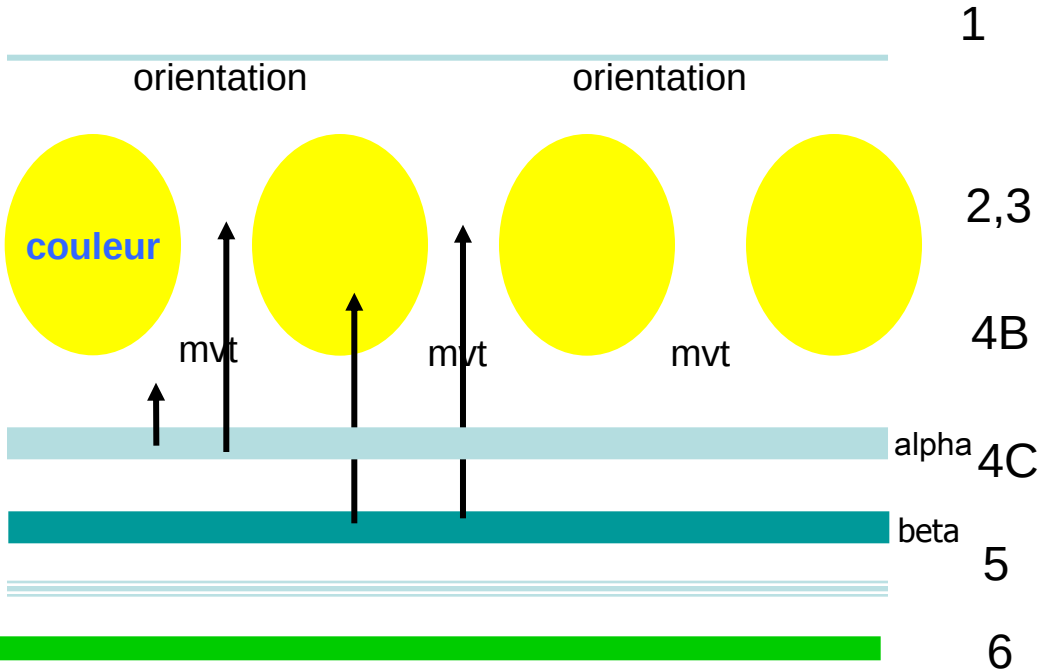
Longueur d'onde

Ségrégation des informations visuelles

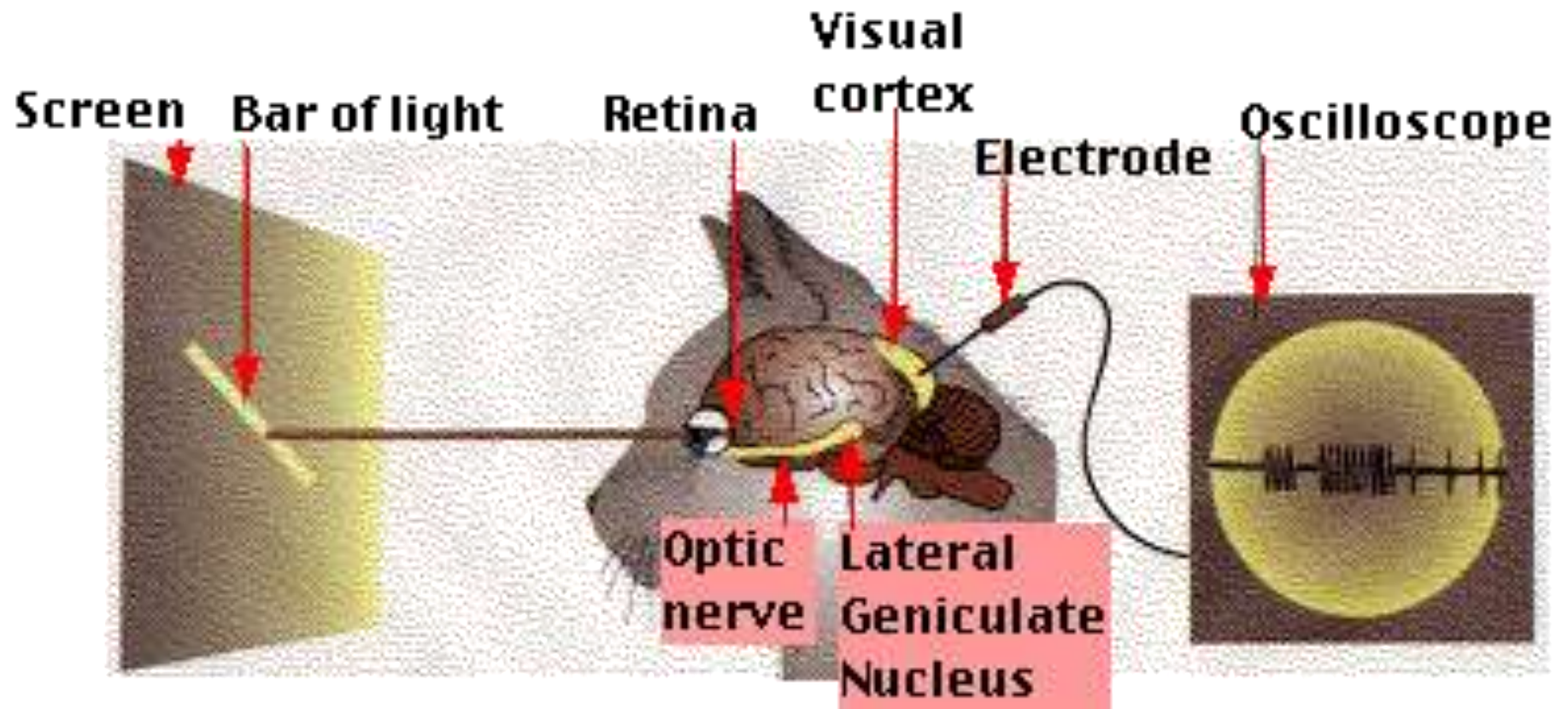


Magnocellulaire

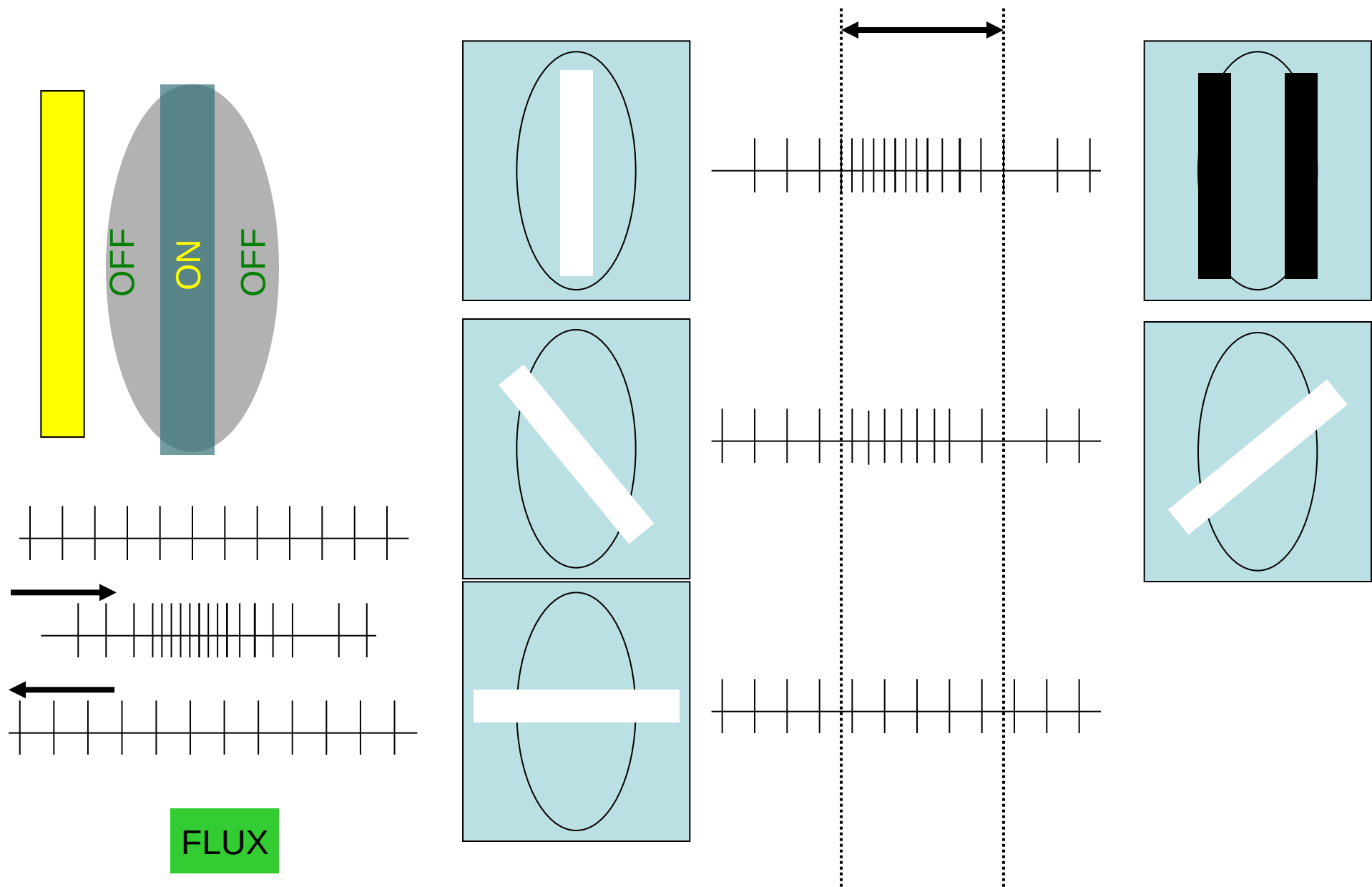
Parvocellulaire



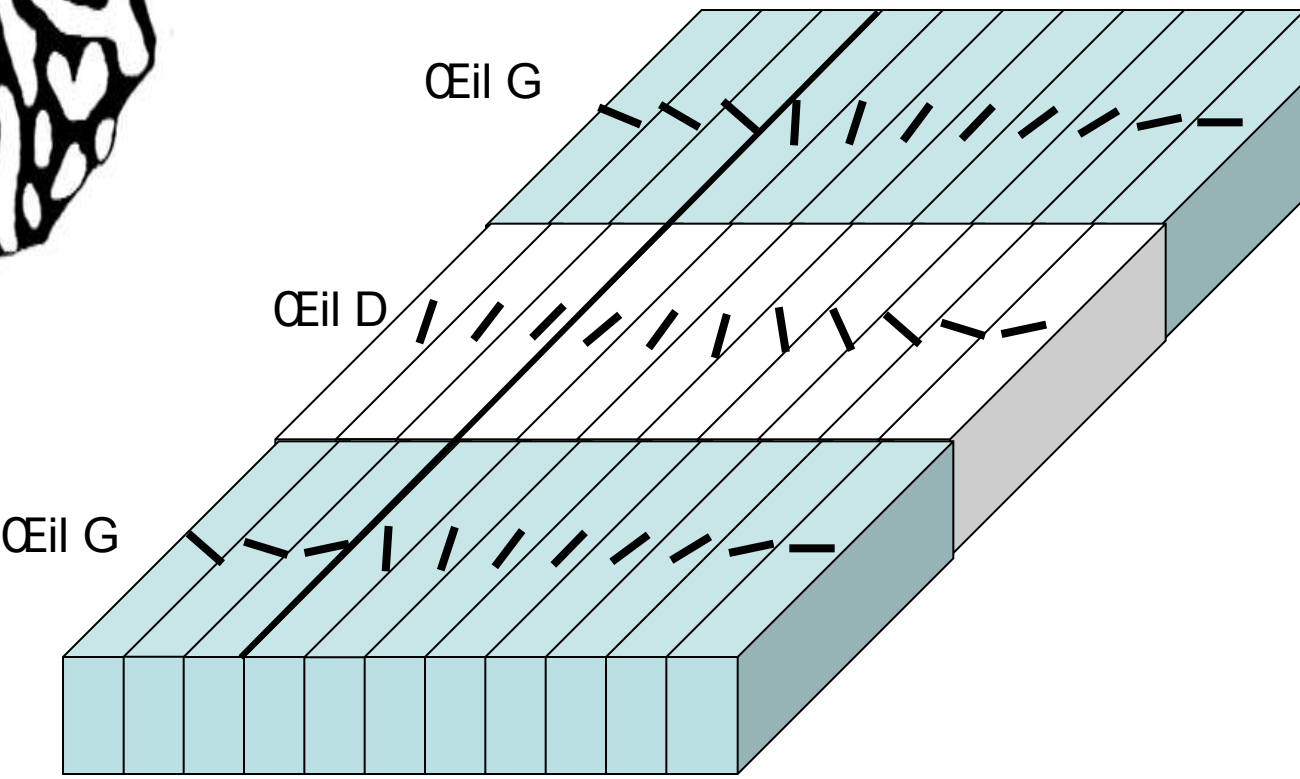
Champs récepteurs



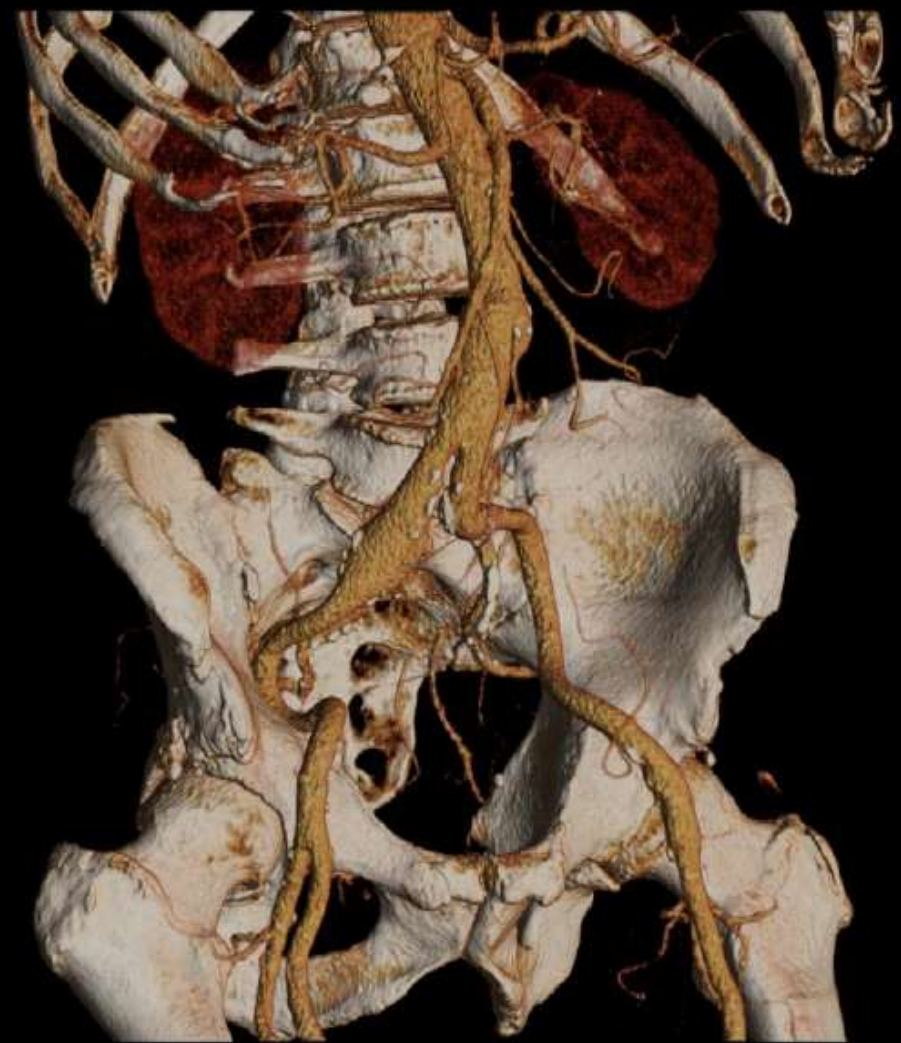
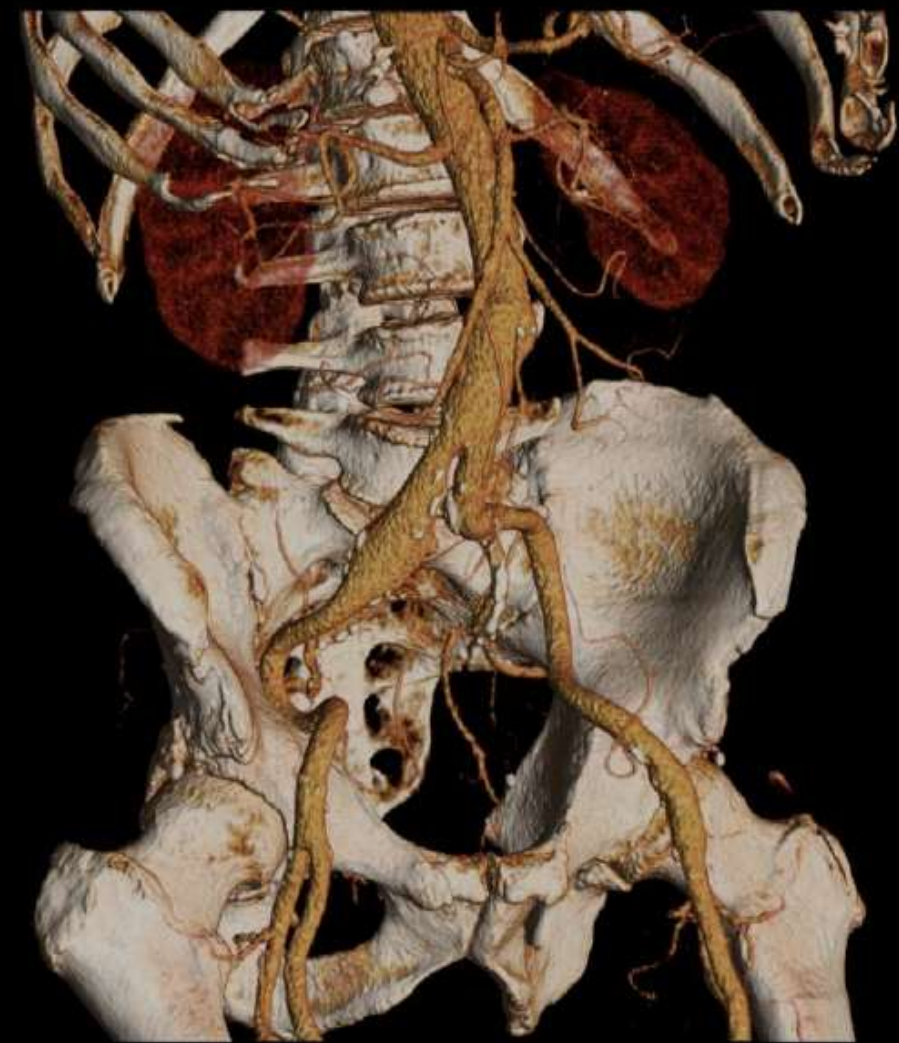
Sensibilité à l'orientation et au mouvement



Colonnes de dominance oculaire



4 Cortex



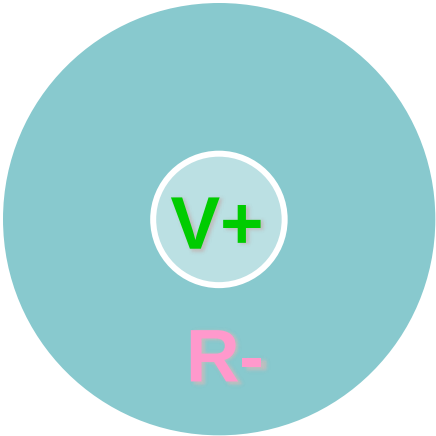
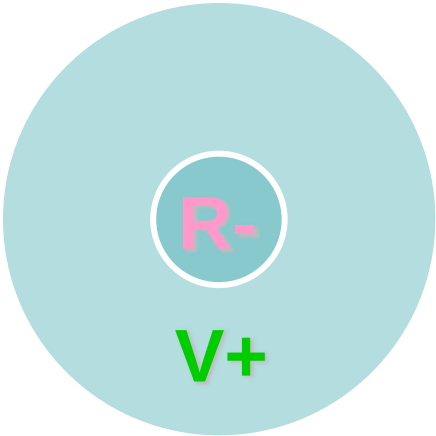
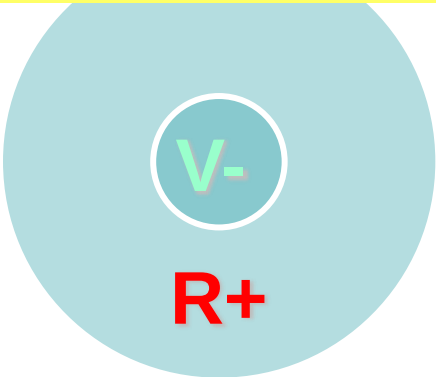
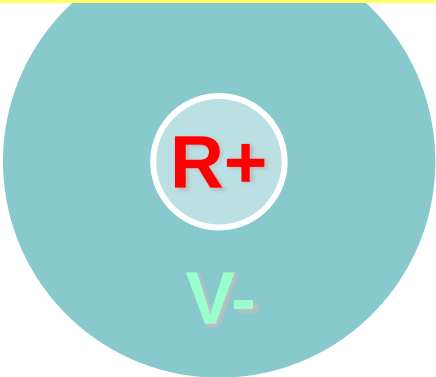


Stéréogramme

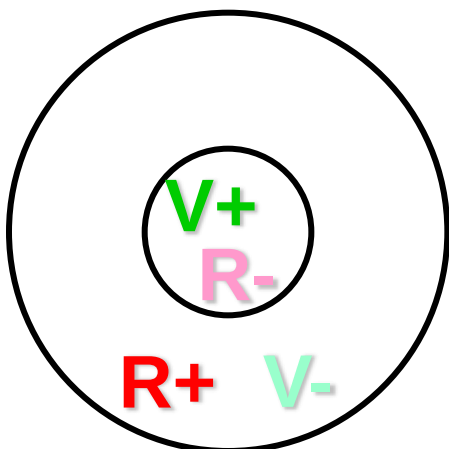
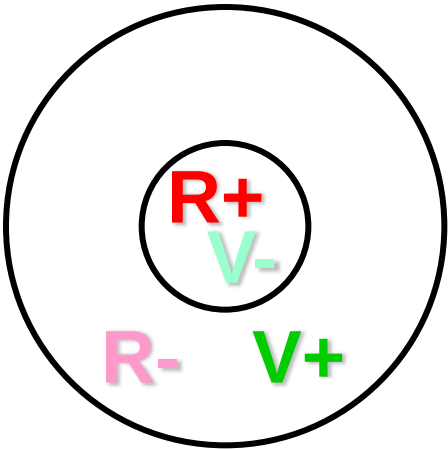


La couleur

Simple opposition
(rétine + cortex)



Double opposition
(cortex)



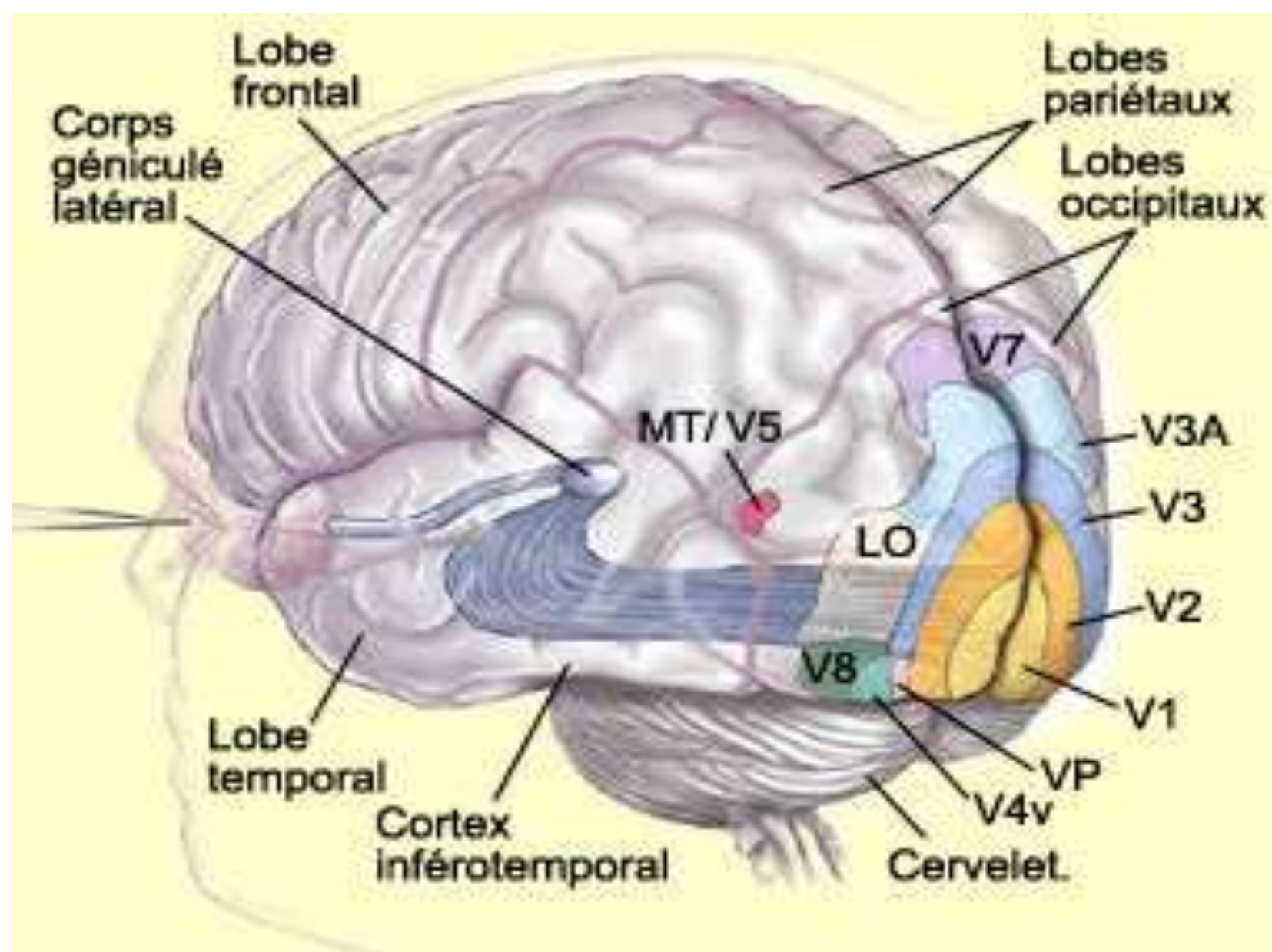




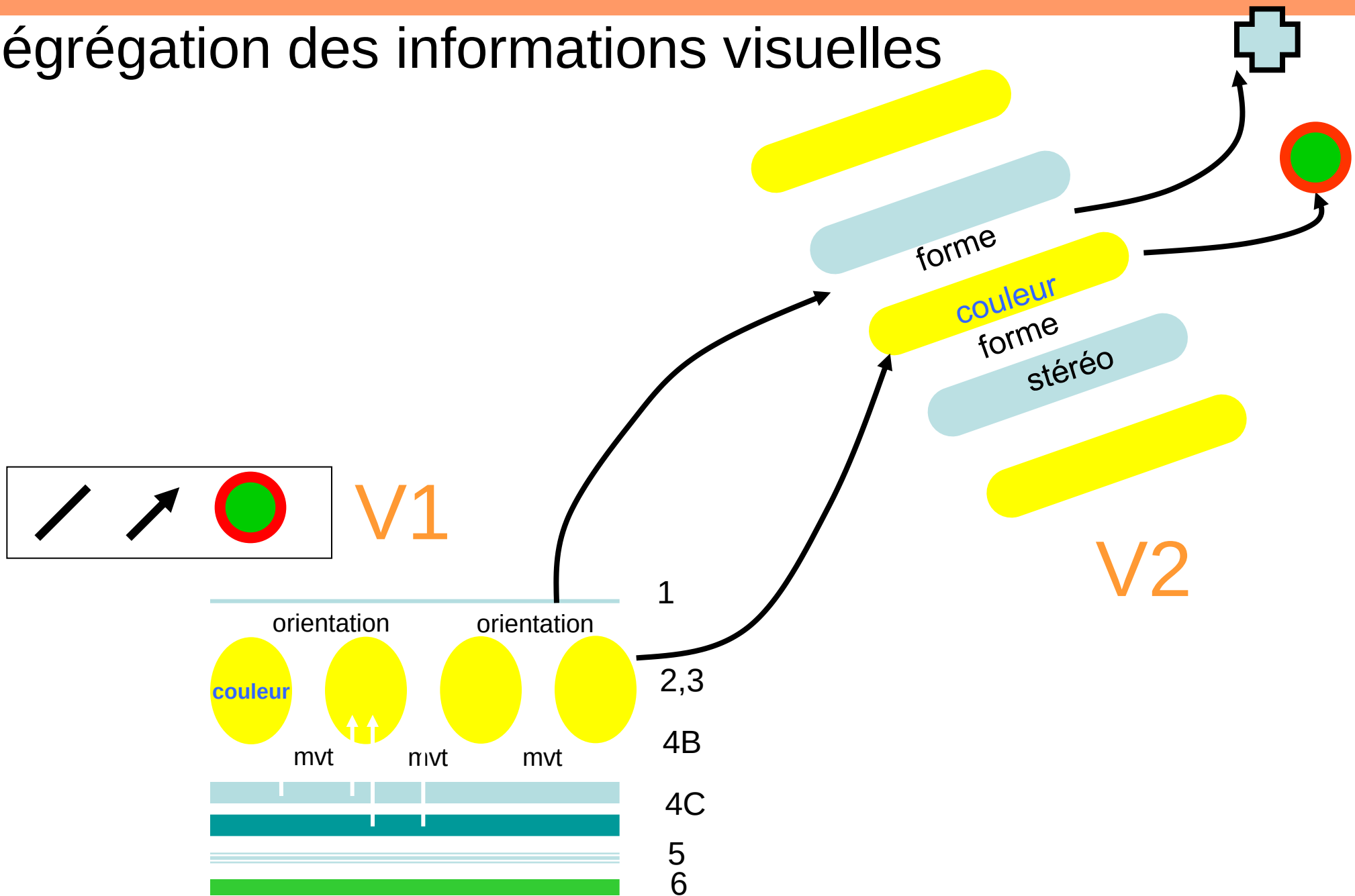
4 Cortex

Opposition rouge-vert

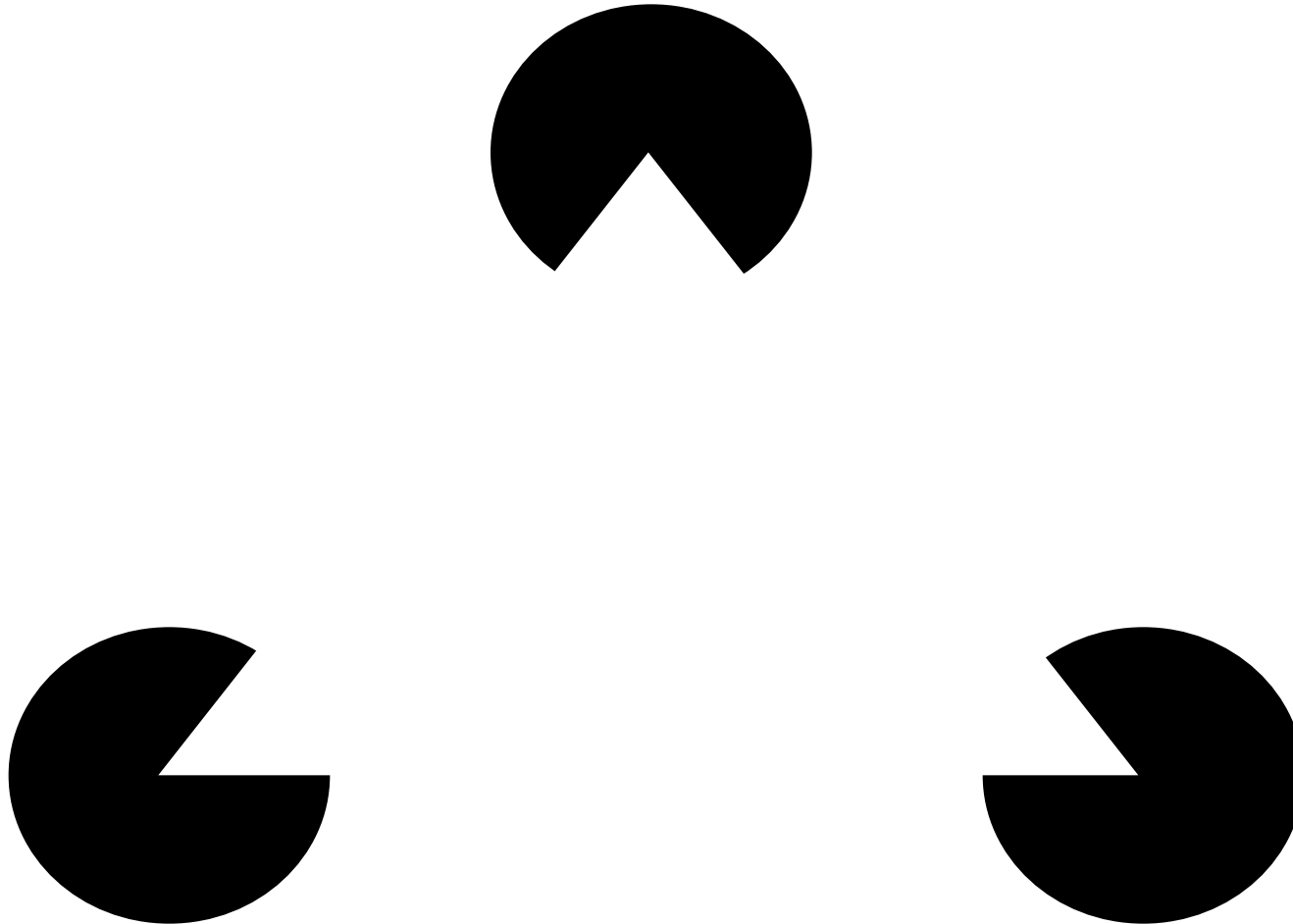
4 Cortex

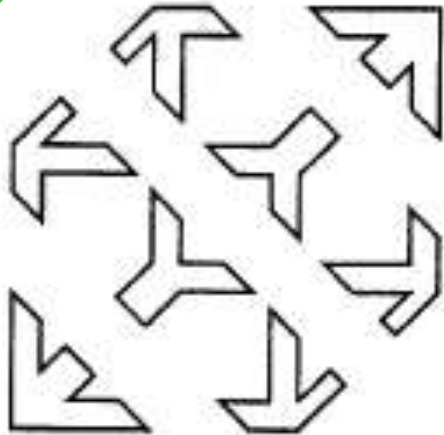
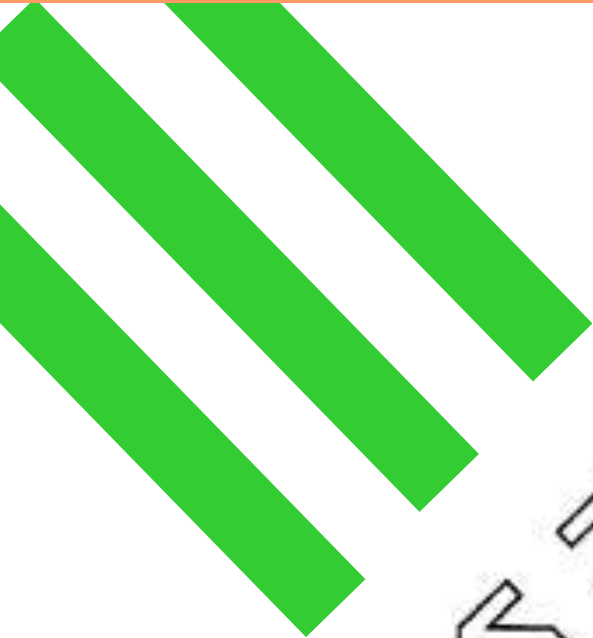


Ségrégation des informations visuelles

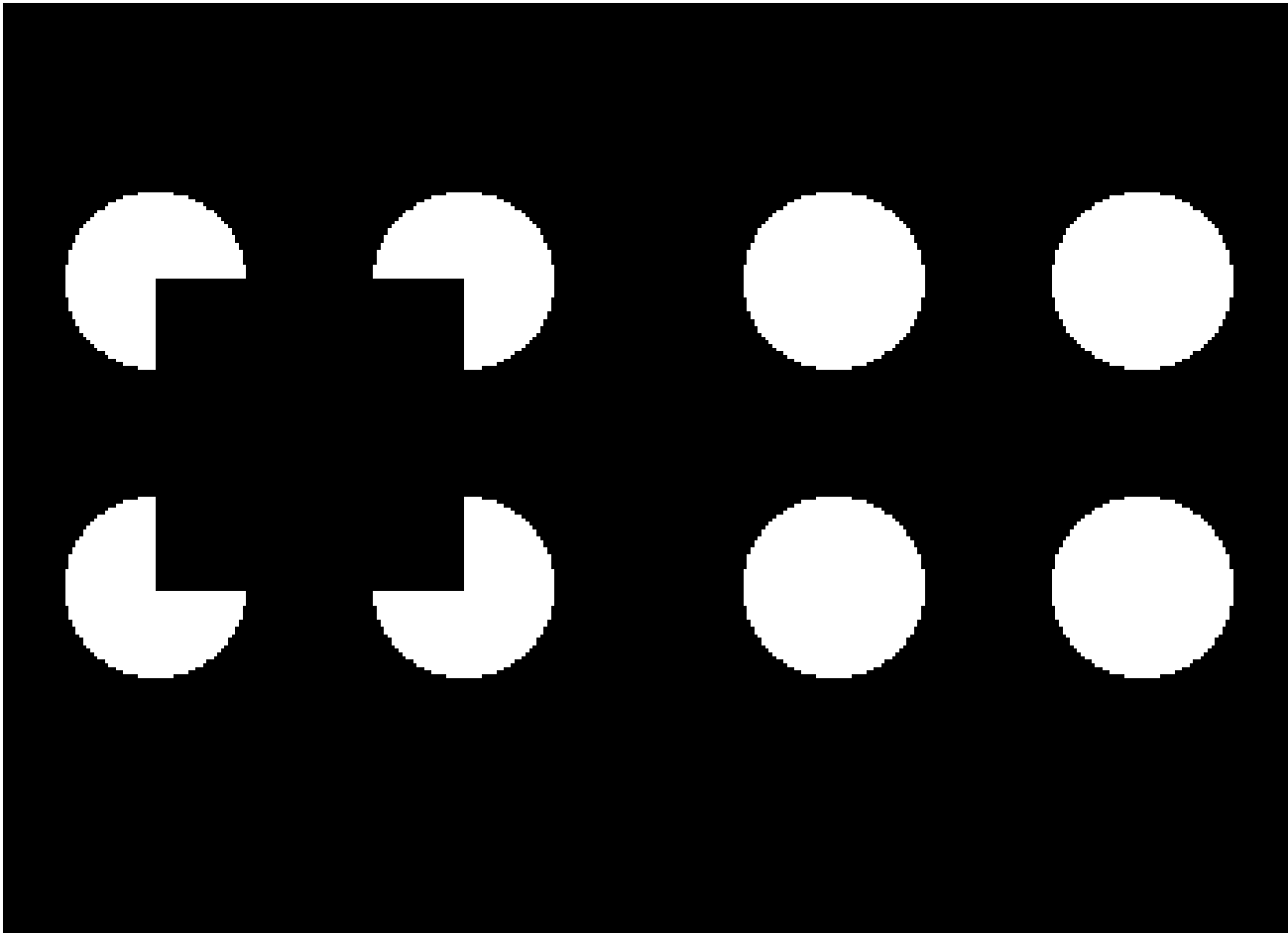


V2: Contours illusoires

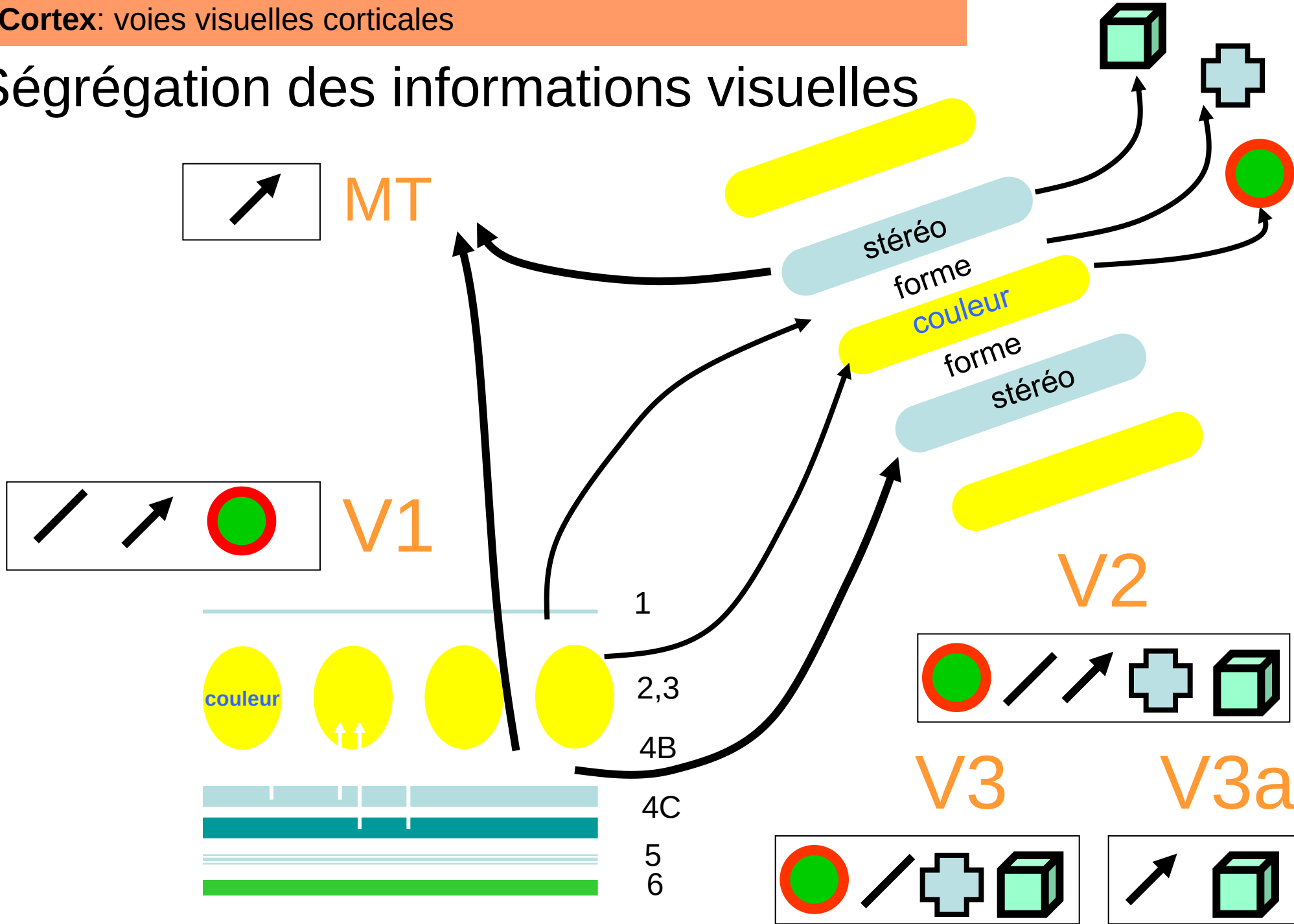




Contours illusoires: mouvement apparent



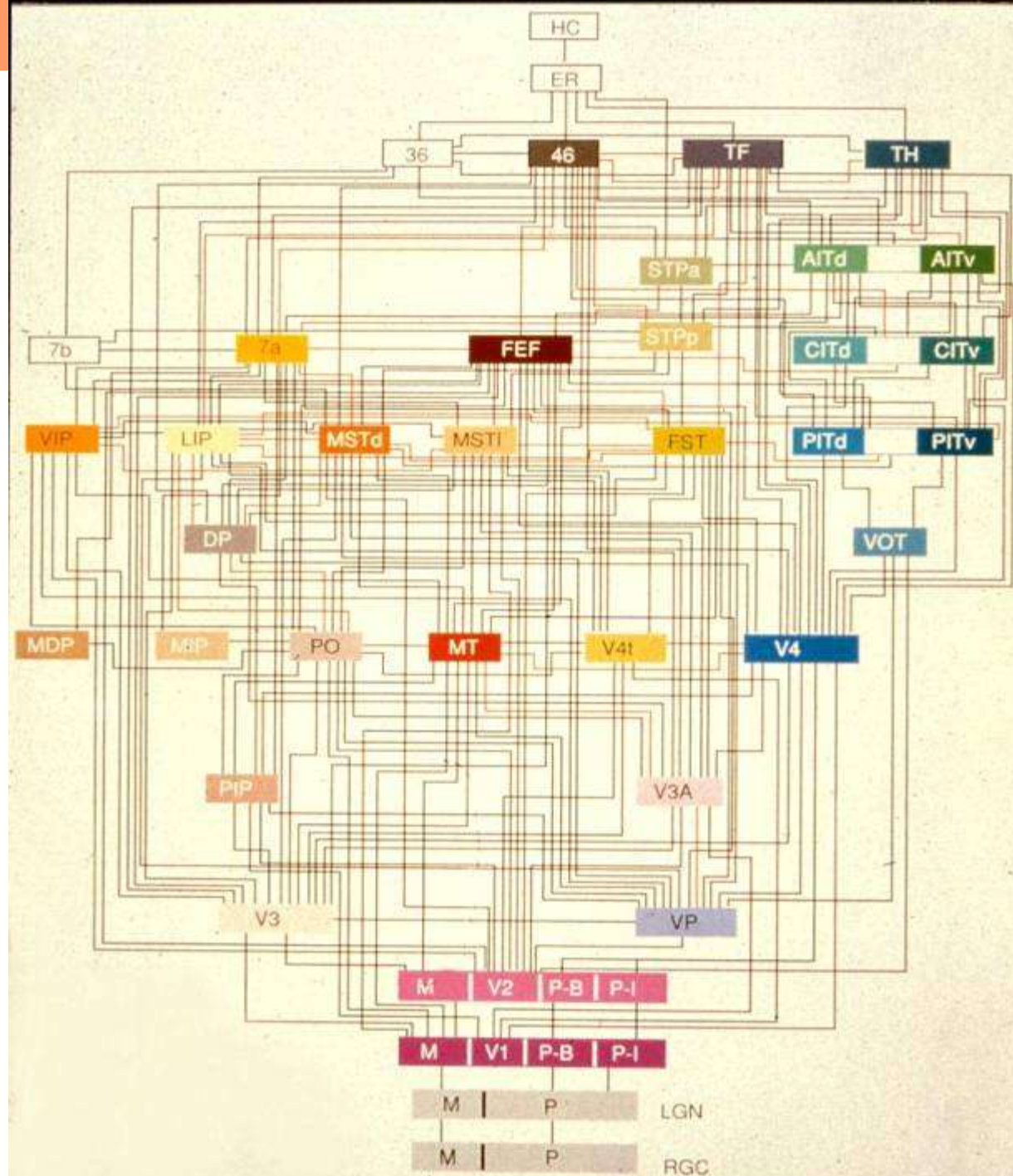
Ségrégation des informations visuelles



Electrophysiologie + neuroanatomie du singe:

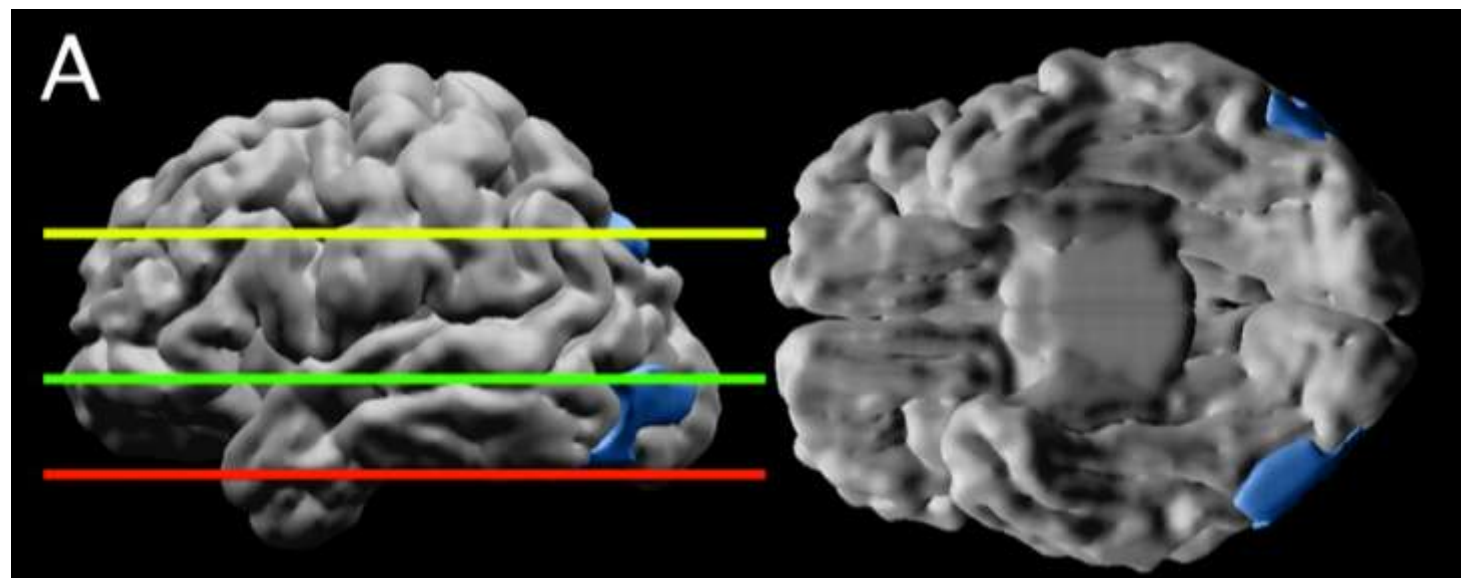
Des réseaux corticaux

Des aires plus ou moins
spécialisées

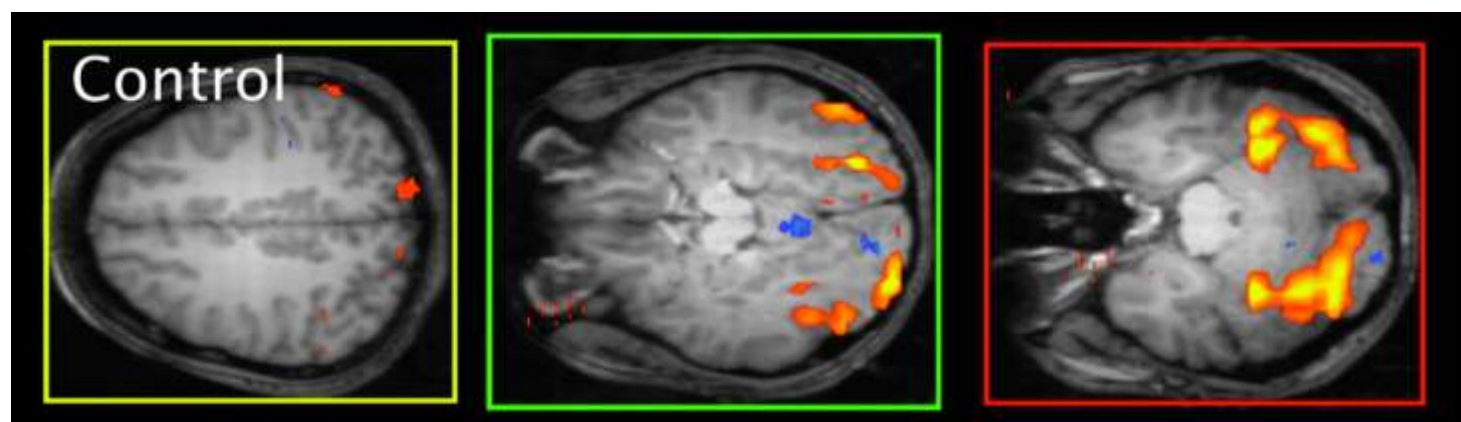


Deux approches chez l'homme

Exemple: la reconnaissance d'objet

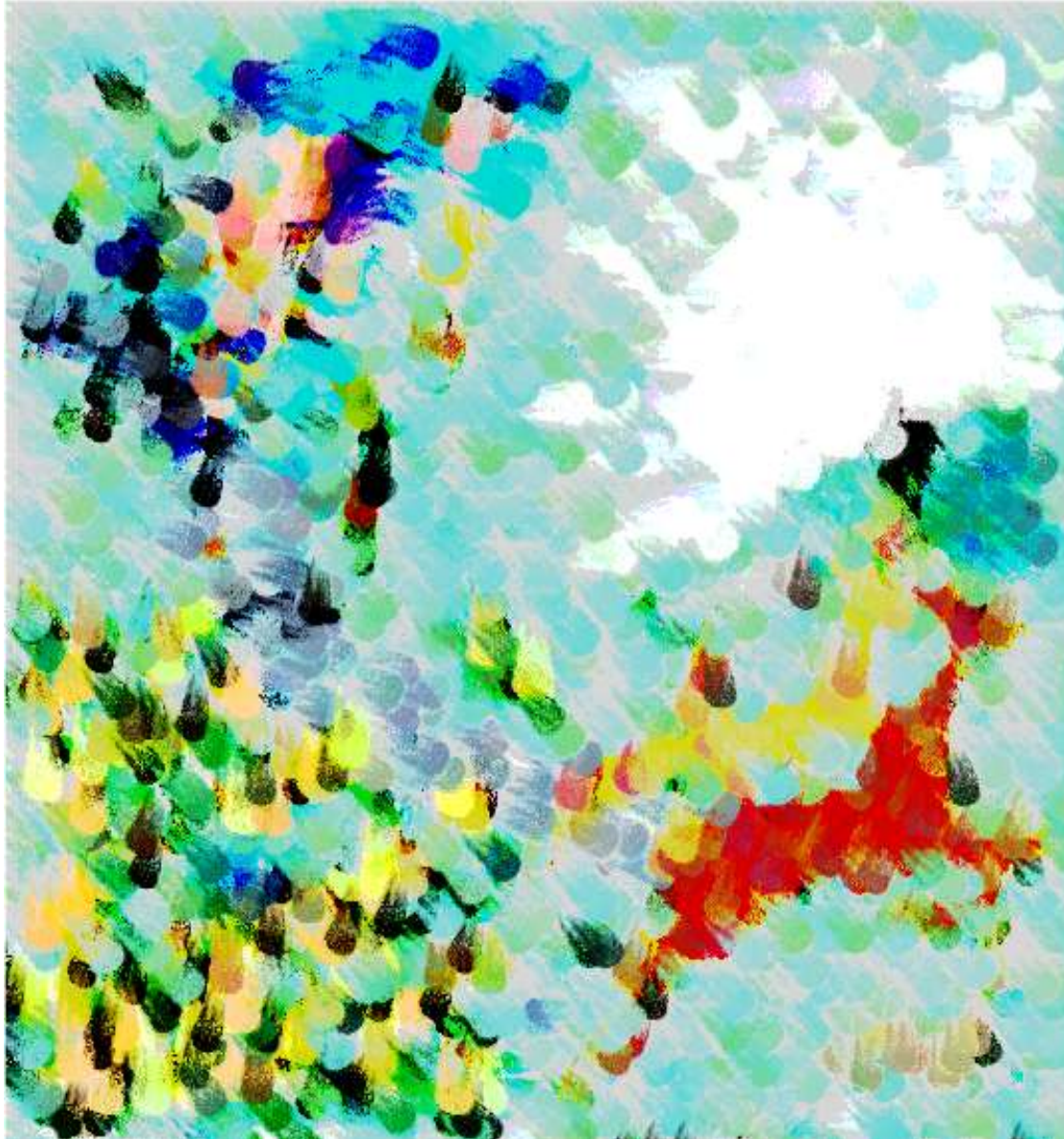


Agnosie
Visuelle

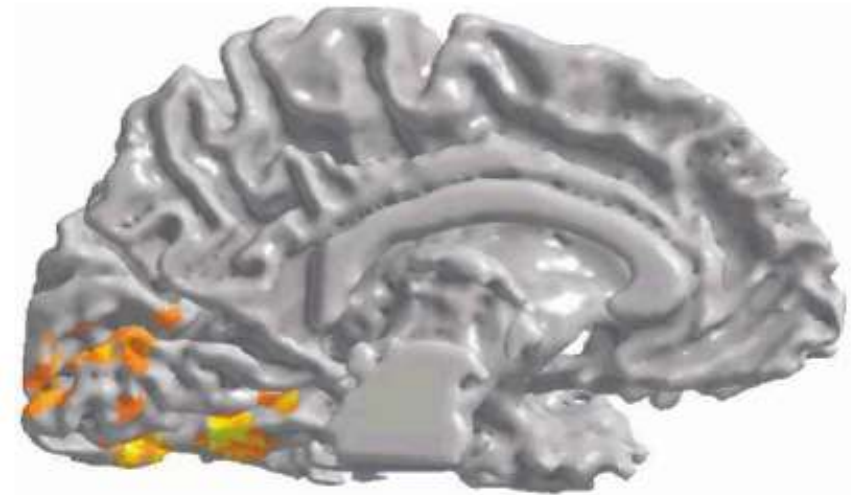
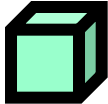
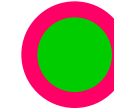


Complexe
Occipital
Lateral

couleur ●



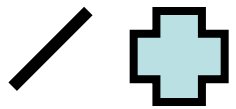
Aire V4?



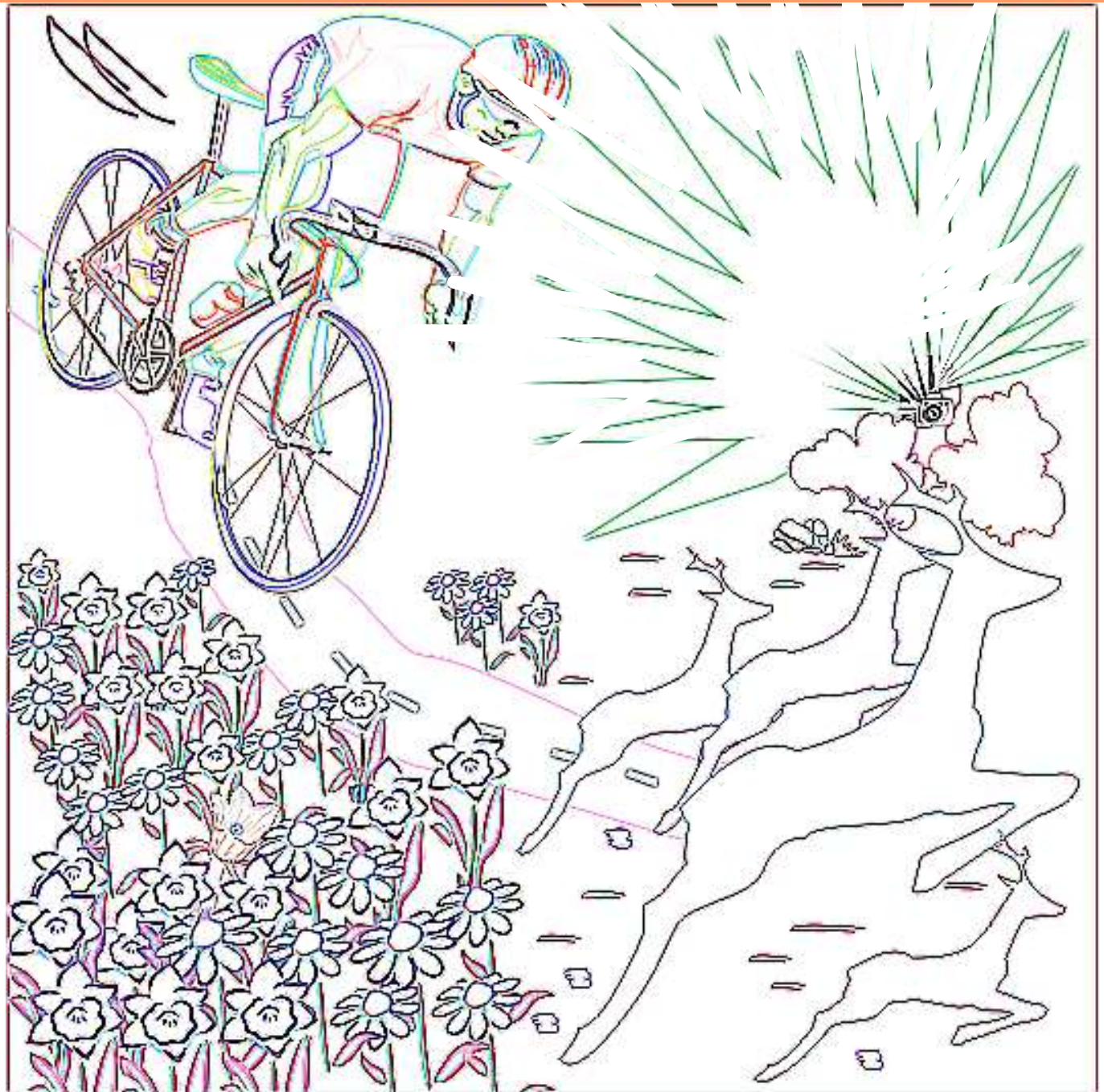
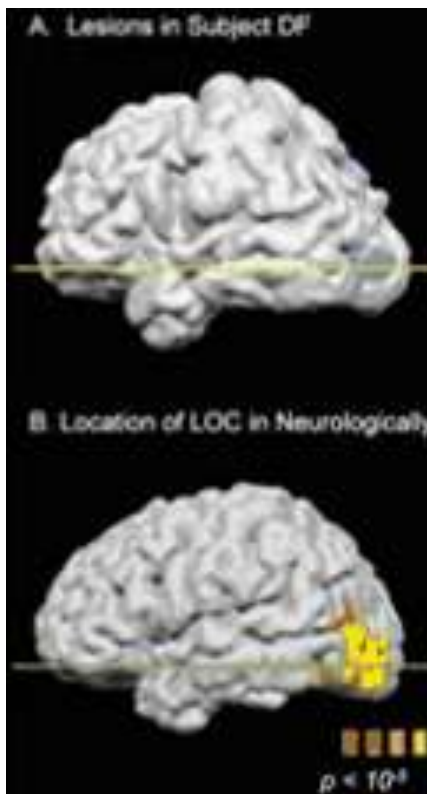
Wade et al. 2002

Achromatopsie,
Agnosie des couleurs

Formes



COL et CIT



Agnosie des formes

Objets

Inféro-Temporal

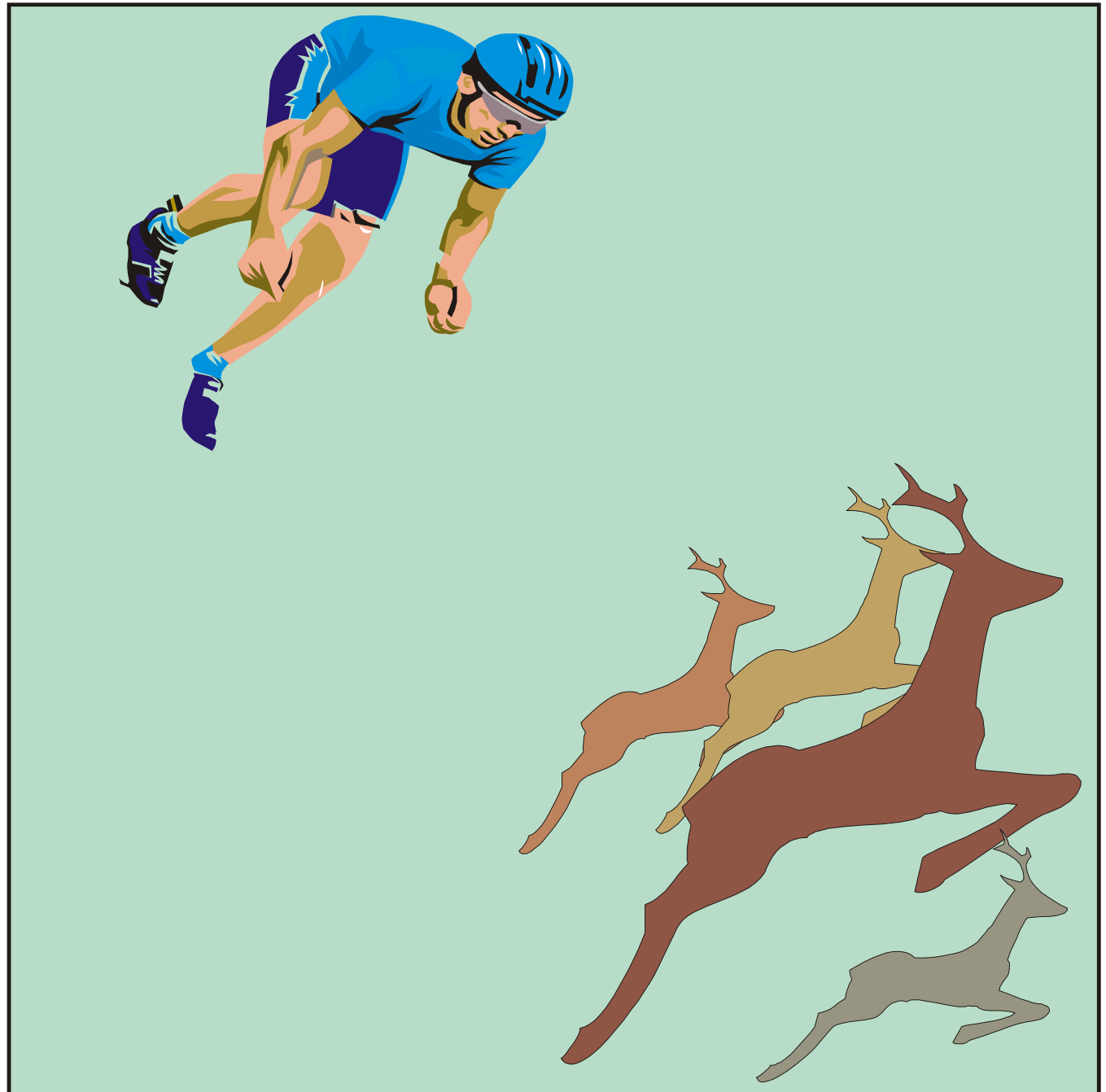


Agnosie des objets

animaux

Inféro-Temporal

Agnosies
spécifiques



visage

Inféro-Temporal



prosopagnosie

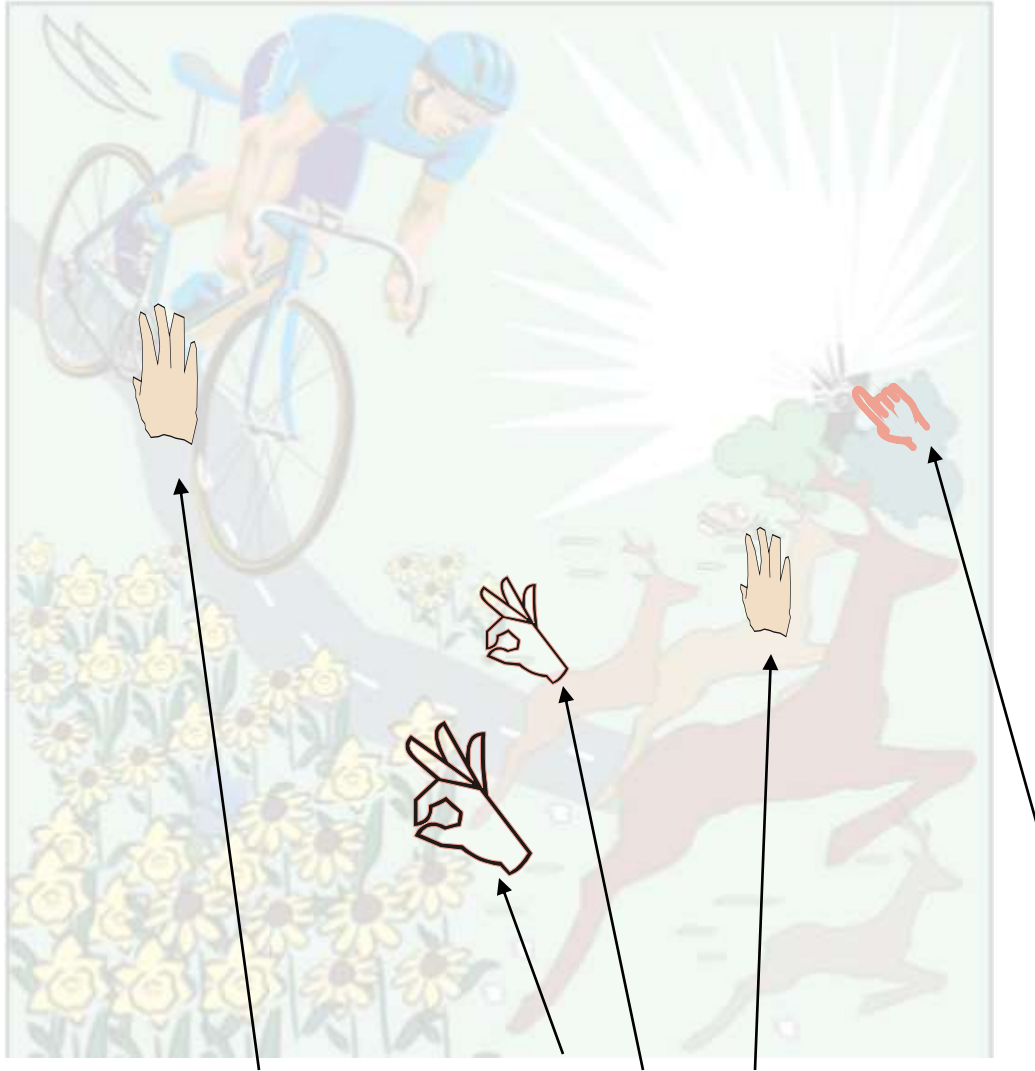
le mouvement



Aire V5 (MT)

akinetopsie

L'action visuellement guidée



Aire V6 (PO)
Cortex pariétal postérieur

Ataxie optique

4 Cortex: voies visuelles corticales

Tms

0



400

960



2080



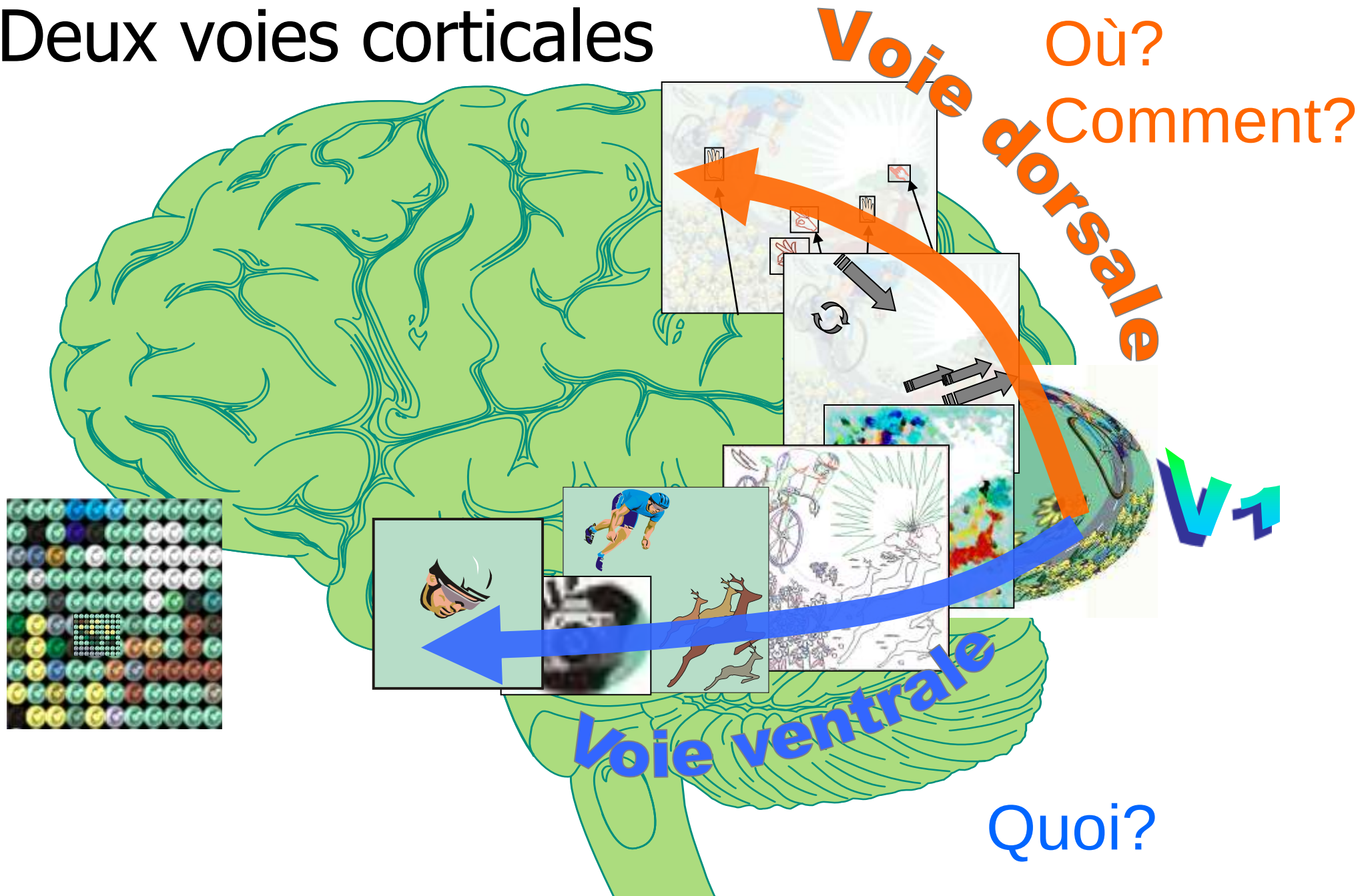
Vighetto 1980

4 Cortex: voies visuelles corticales

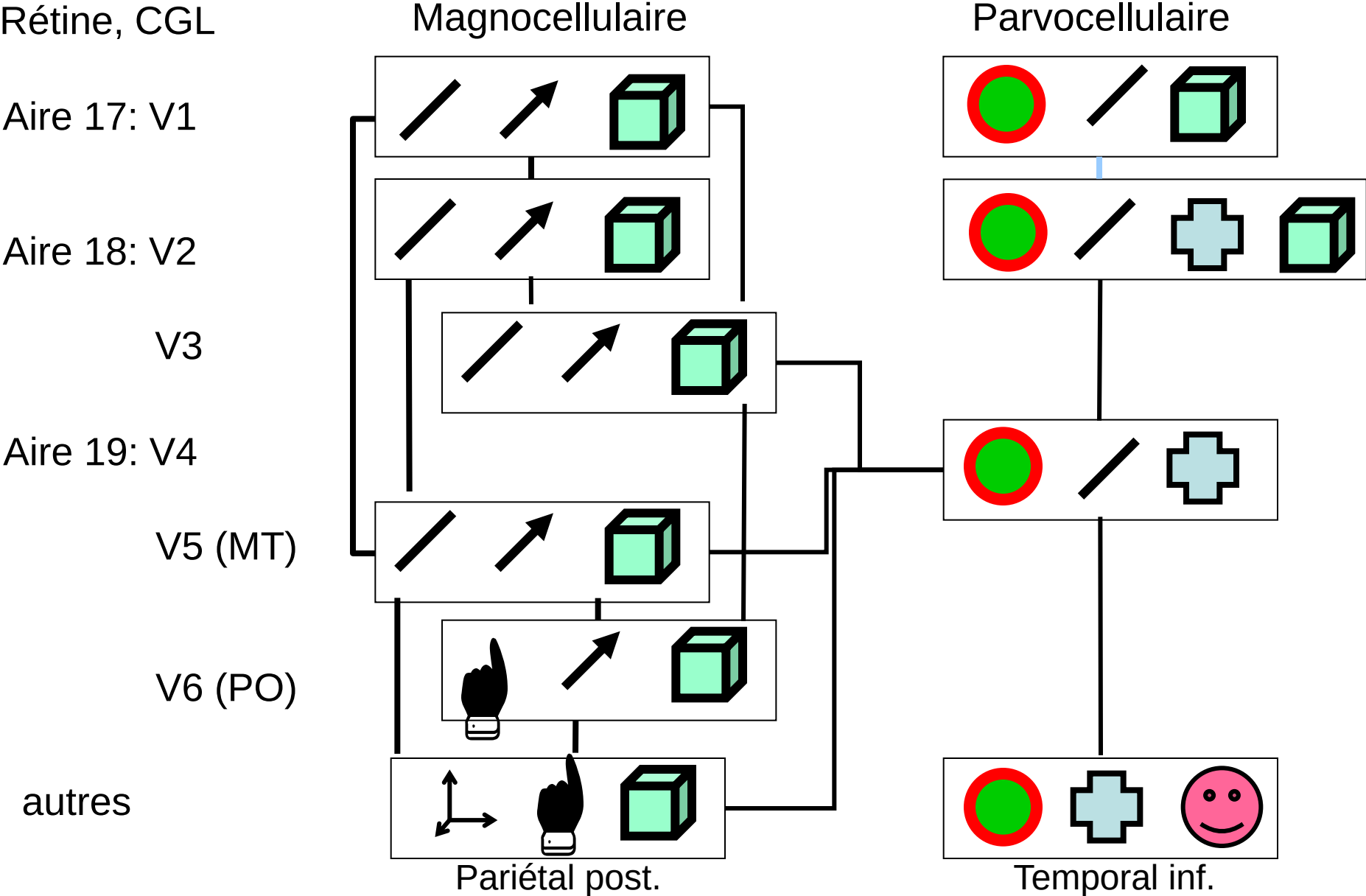


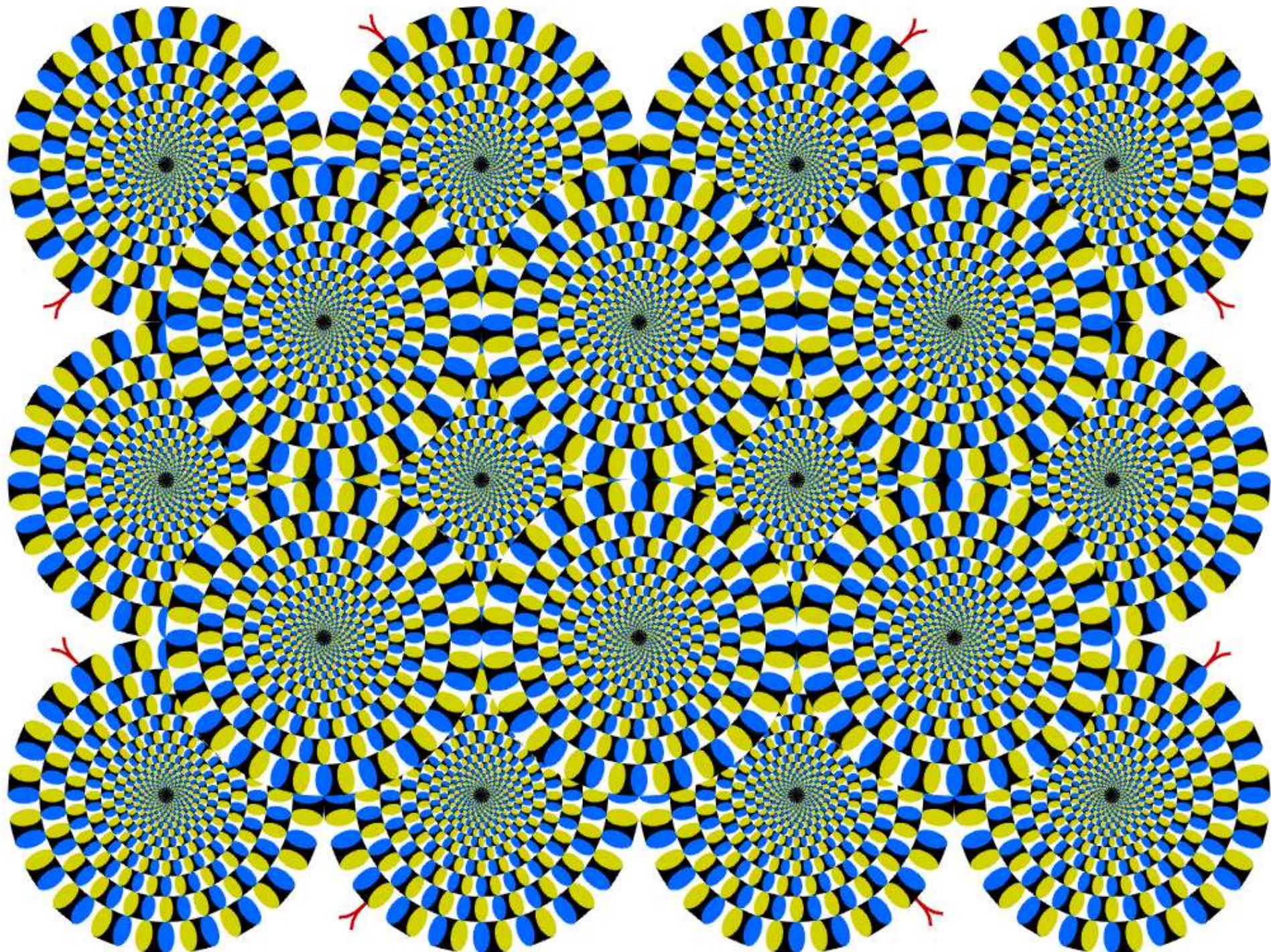
Vighetto 1980

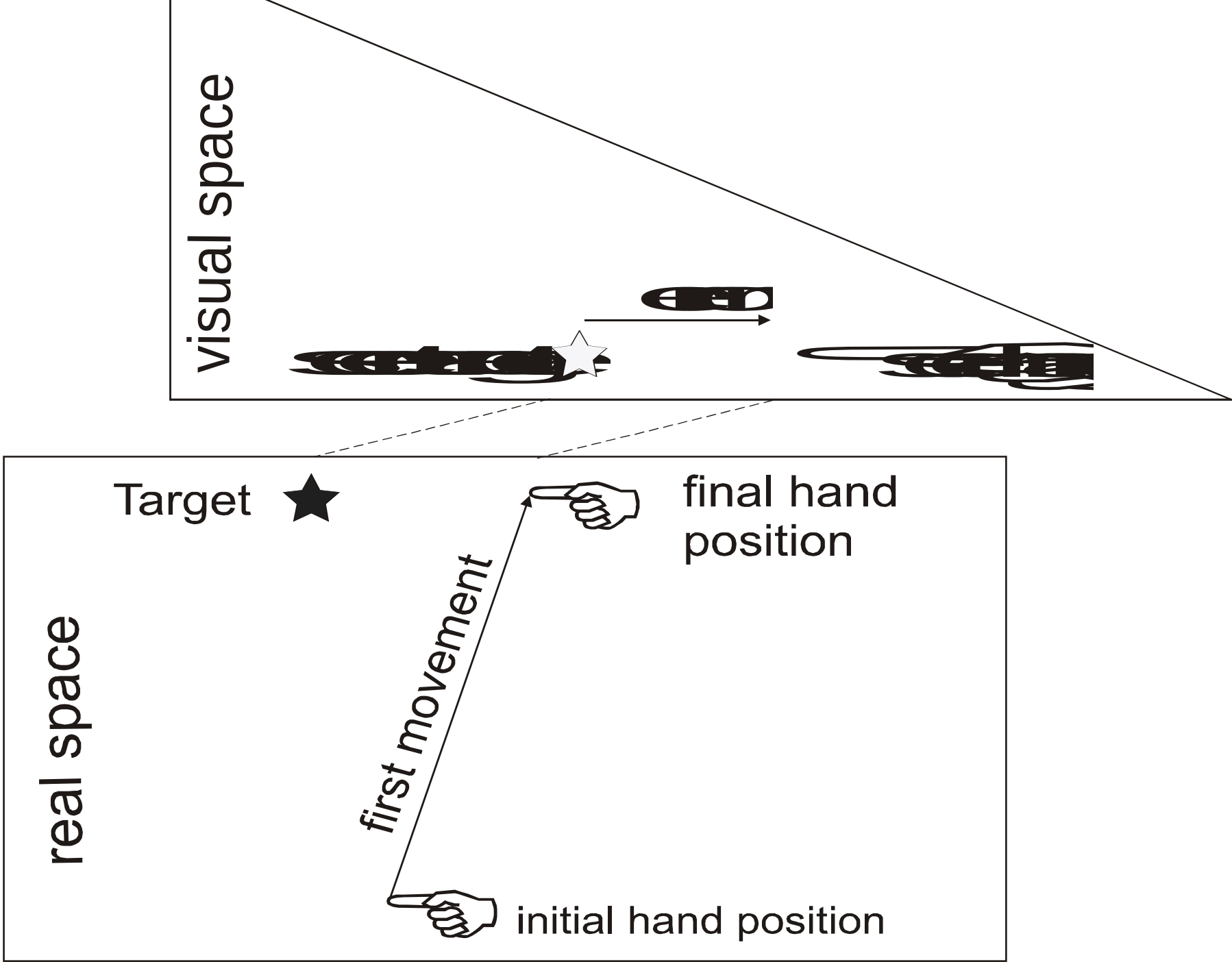
Deux voies corticales

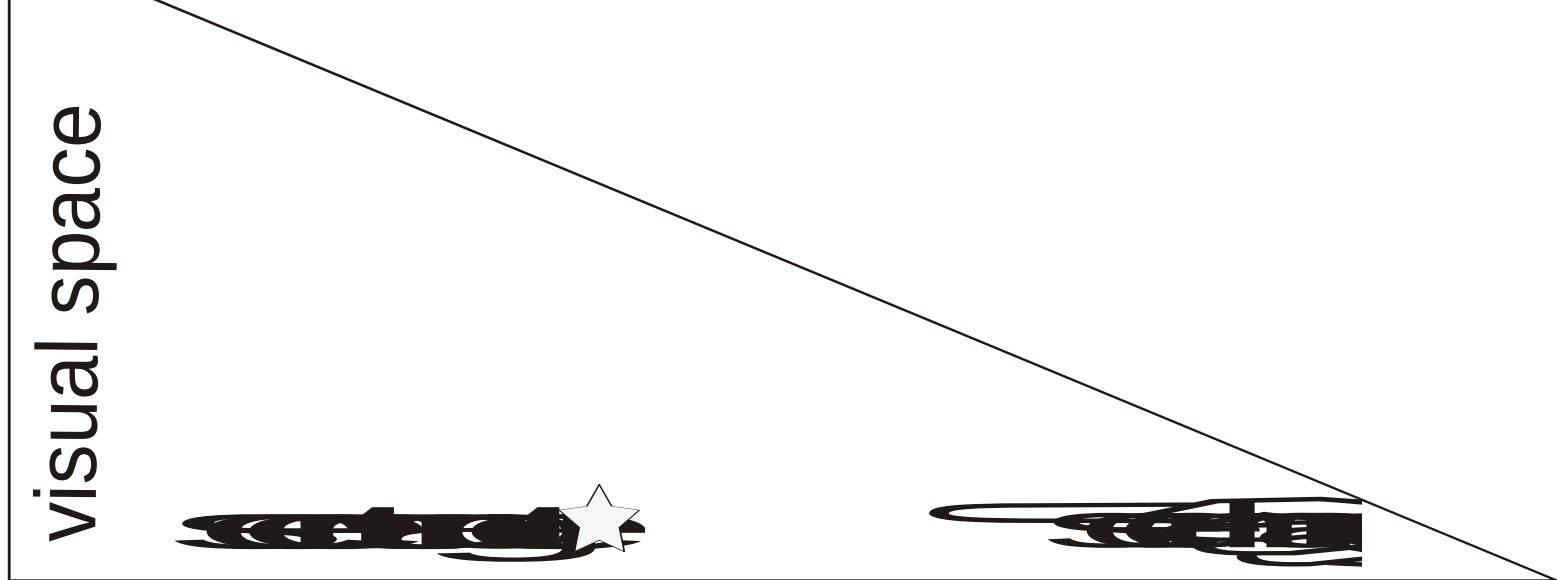
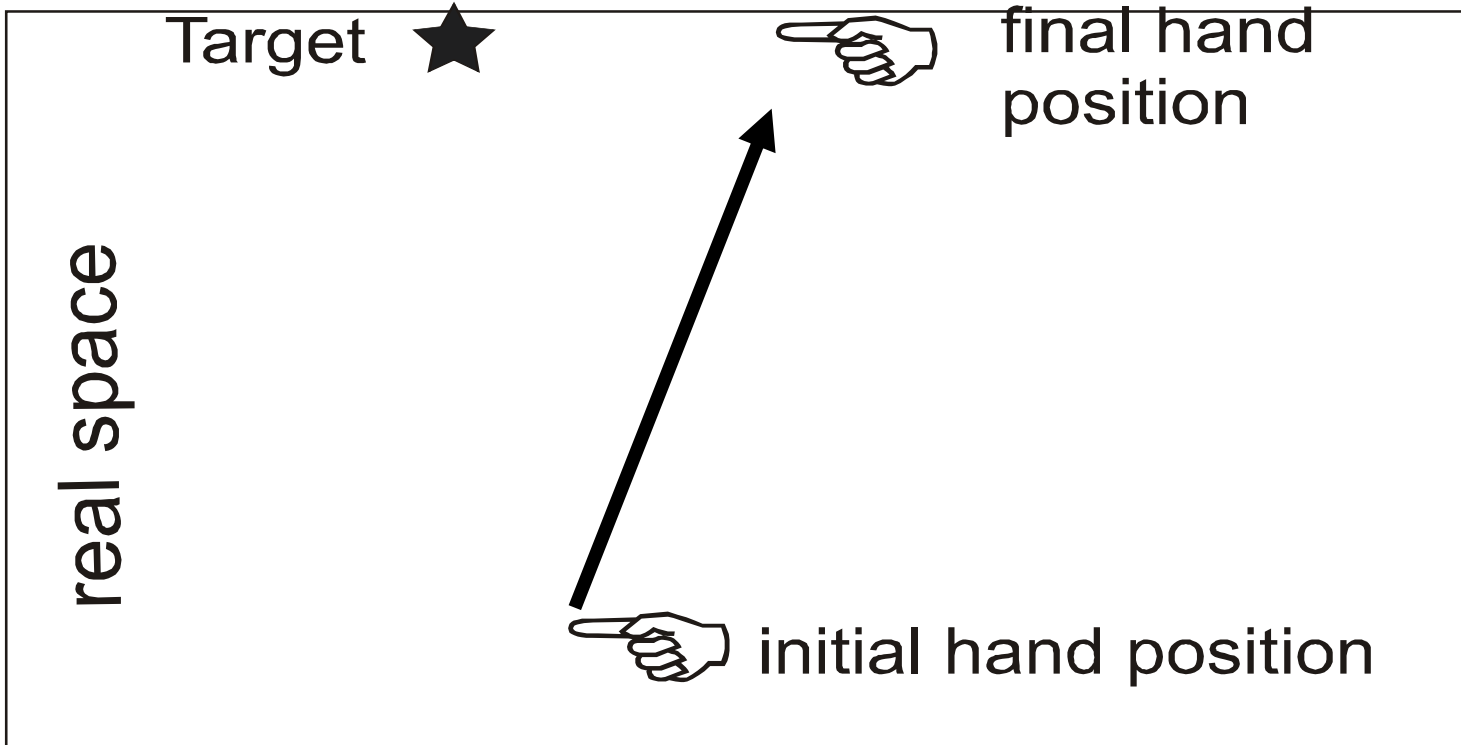


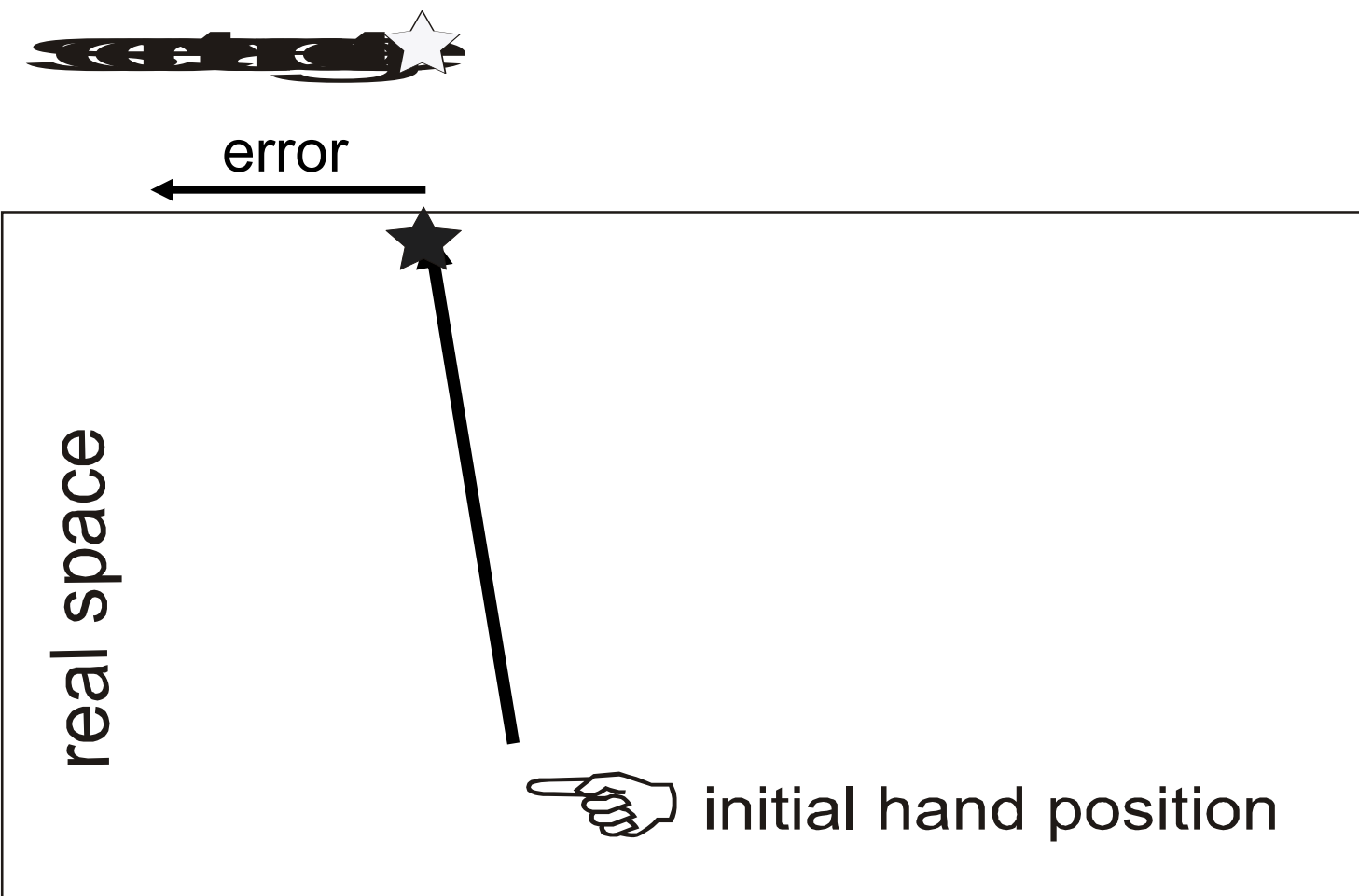
Résumé: les grands canaux visuels





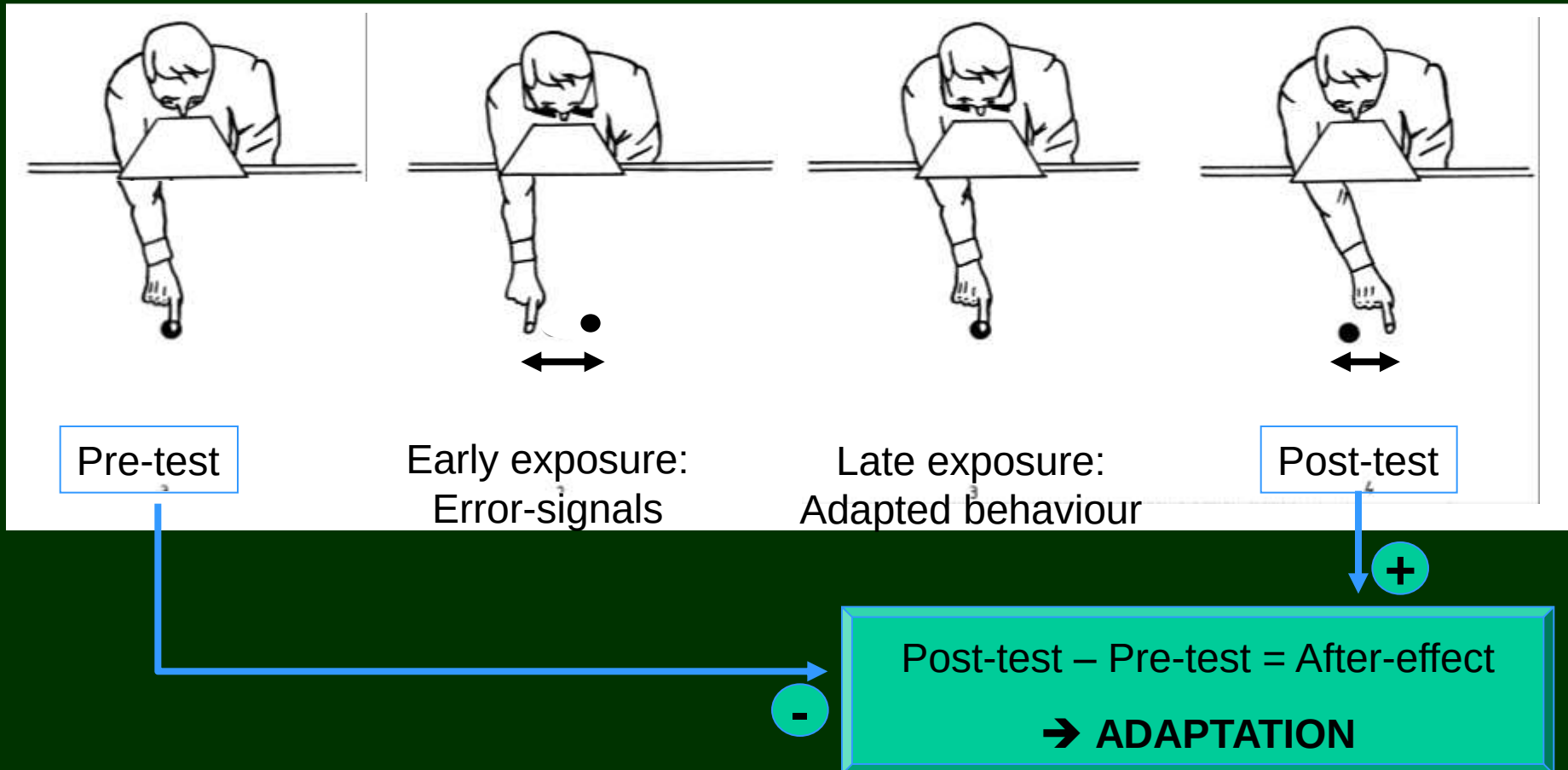






Prism adaptation:

a classical procedure to assess the consequences of exposure



Accuracy (deg)

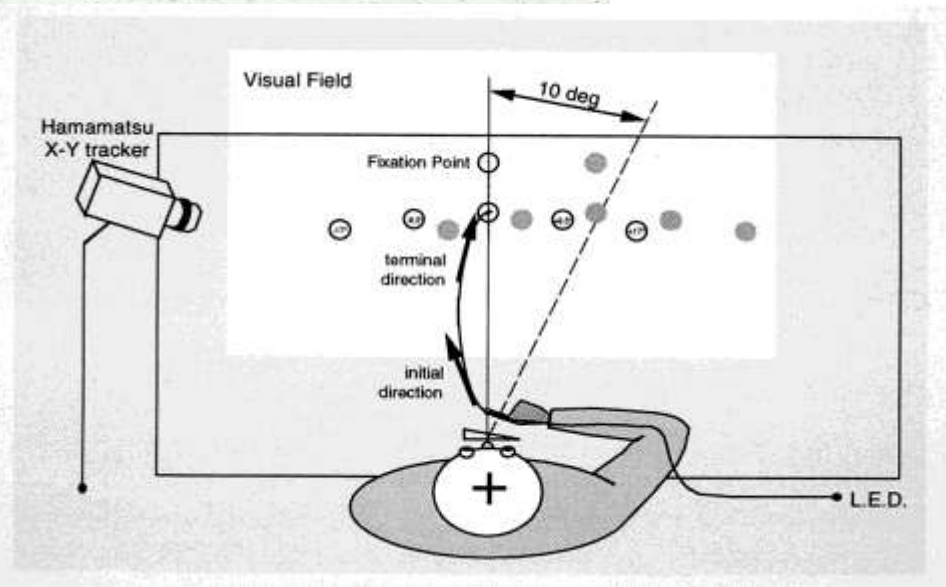
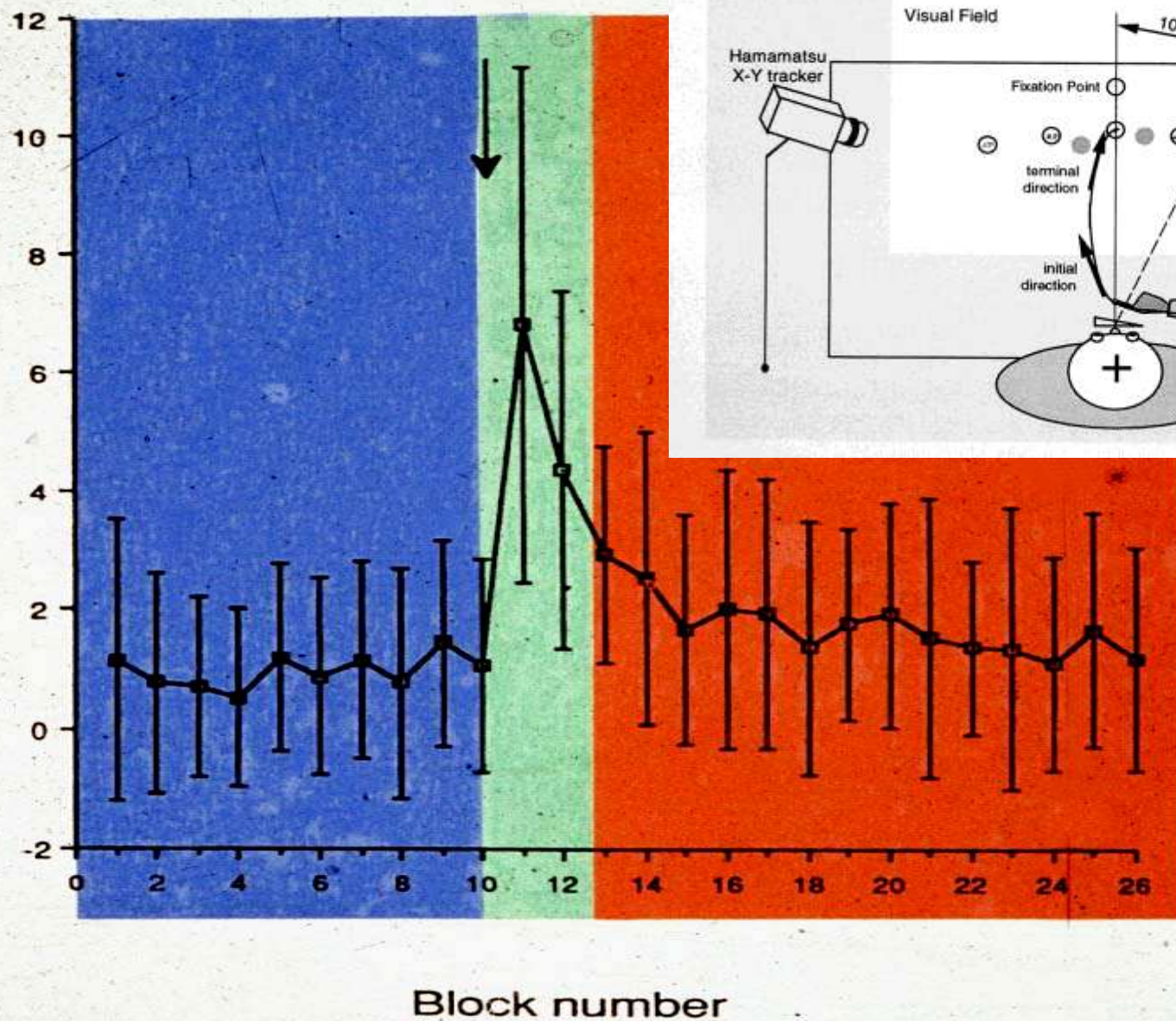


Fig. 4 全26ブロックの、指先指示の指示誤差