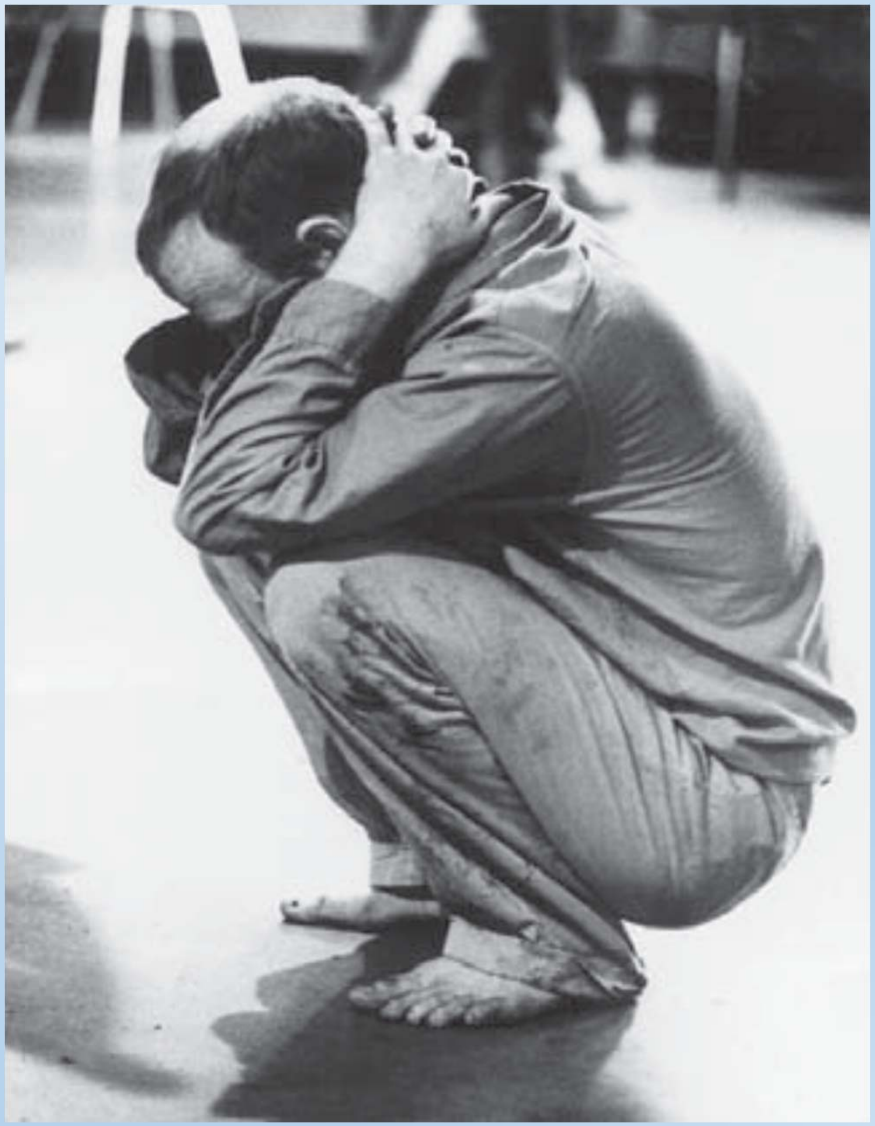
Claude Monet, Impression, soleil levant (Impression, Sunrise), 1872

视觉, 视觉的重要性

- 我们所有的信息,都由感官而来
- 但是我们认知到的世界,不由感官决定
- 我们对于外界的认知, 决定于我们对于世界的建构
  - 有意识的
  - 无意识的
- 视觉是最重要的感官

Louis Wain (5 August 1860 – 4 July 1939)

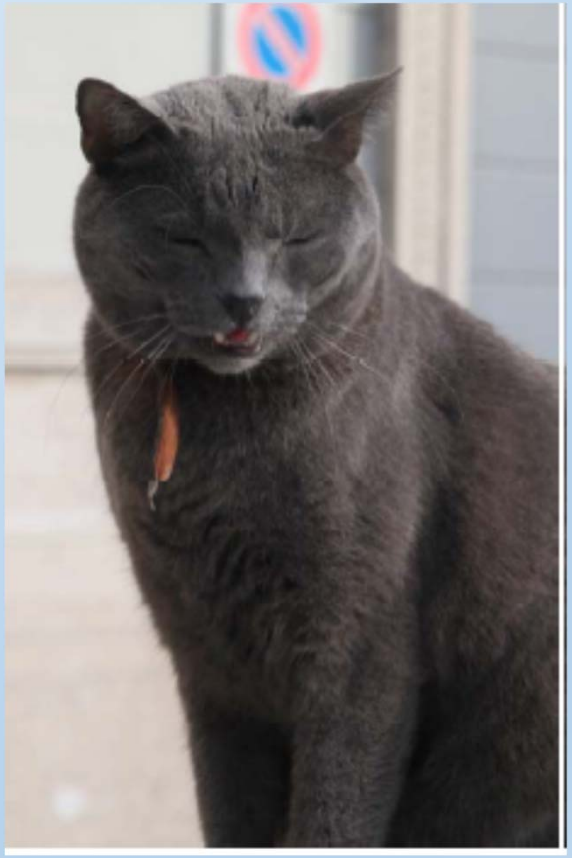
So,



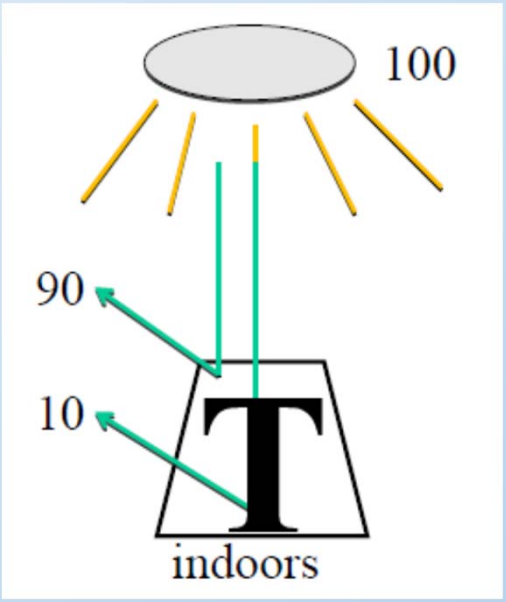
生理心理学视角下的视觉

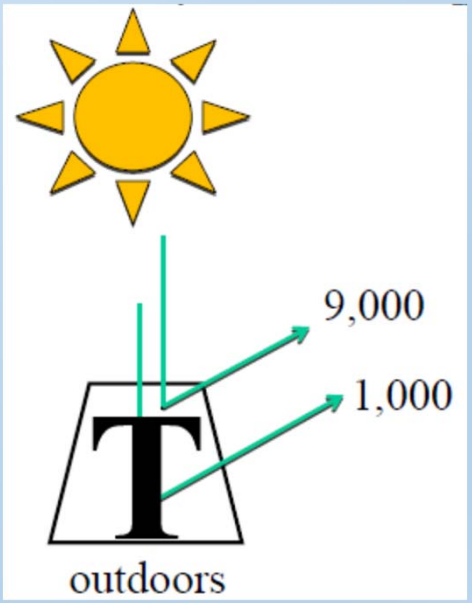
- Why?
- How?

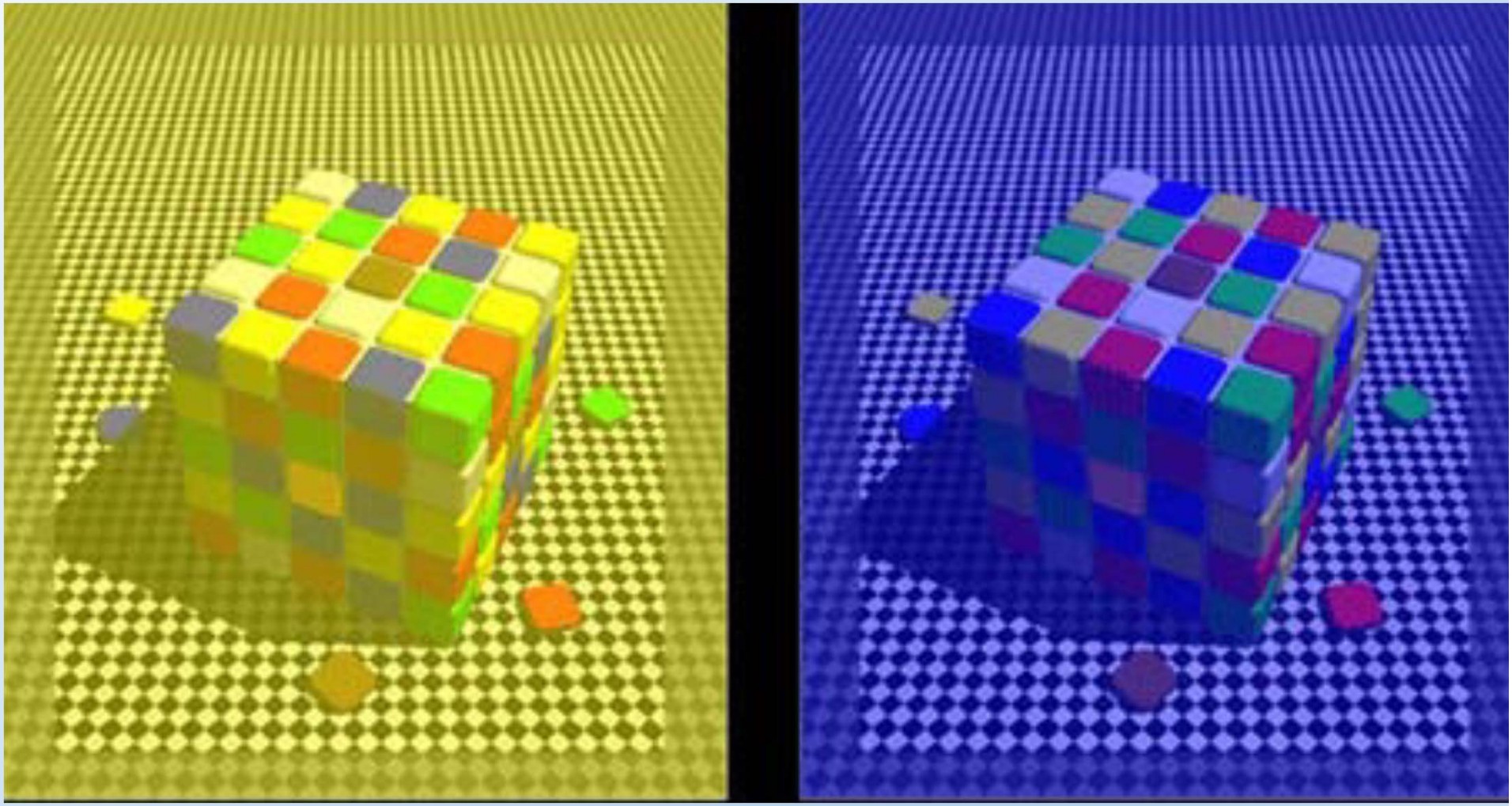
问题提出



Maintain the consistency of world

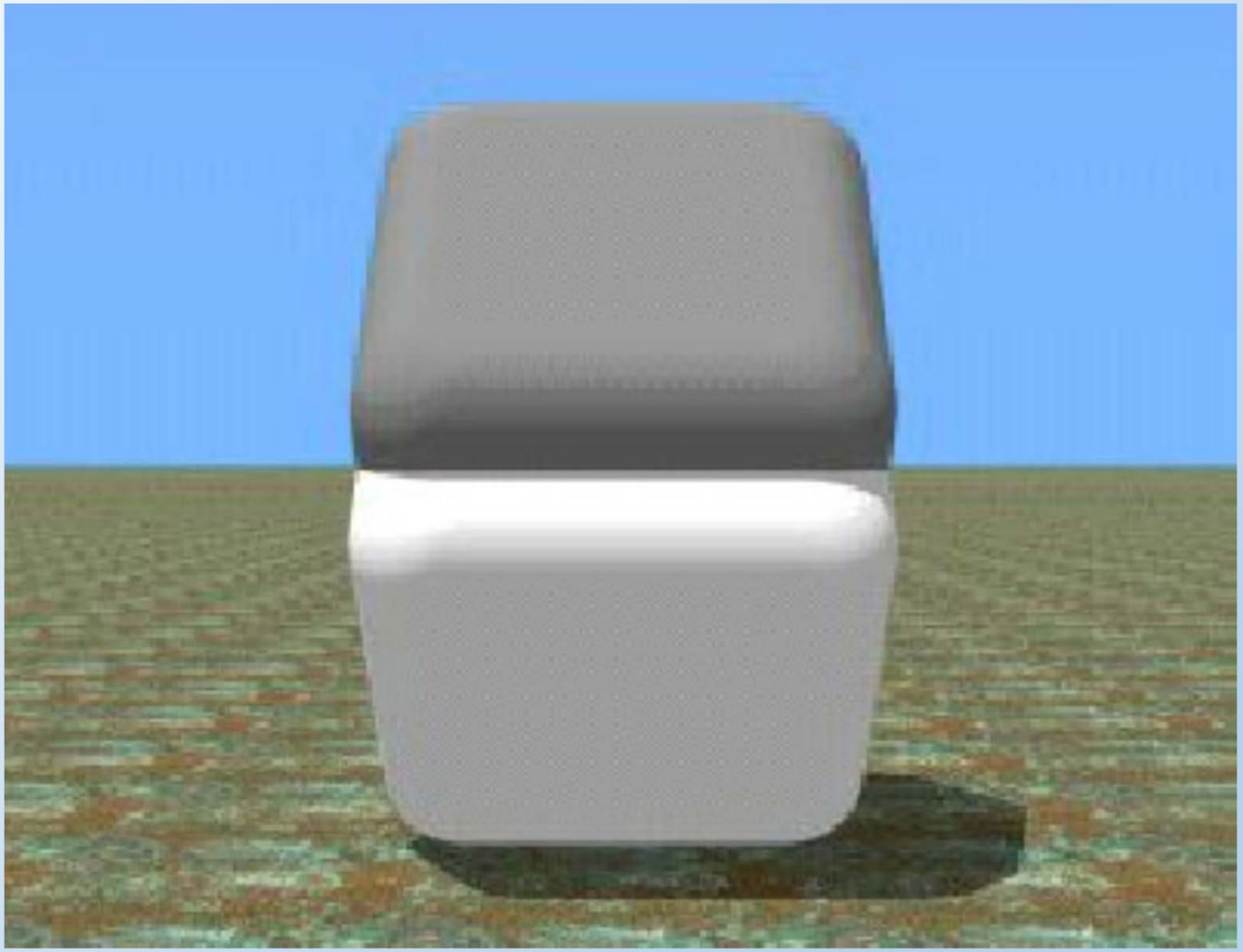




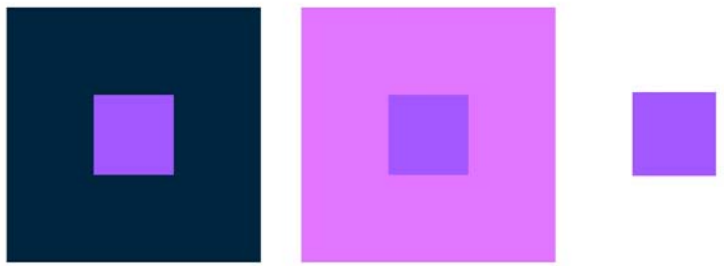


视觉元素是自组织的

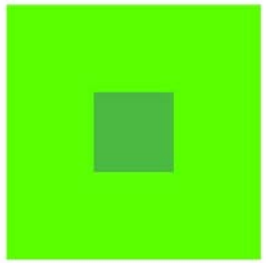
Illustration

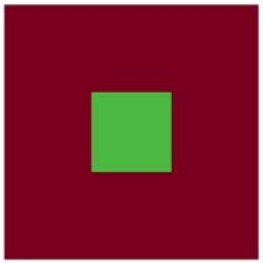


Craik-O’Brien-Cornsweet Illusion



Hue Shift:
The light purple color changes due to the background colors being analogous. One background color is darker and the other is lighter making the colors shift.

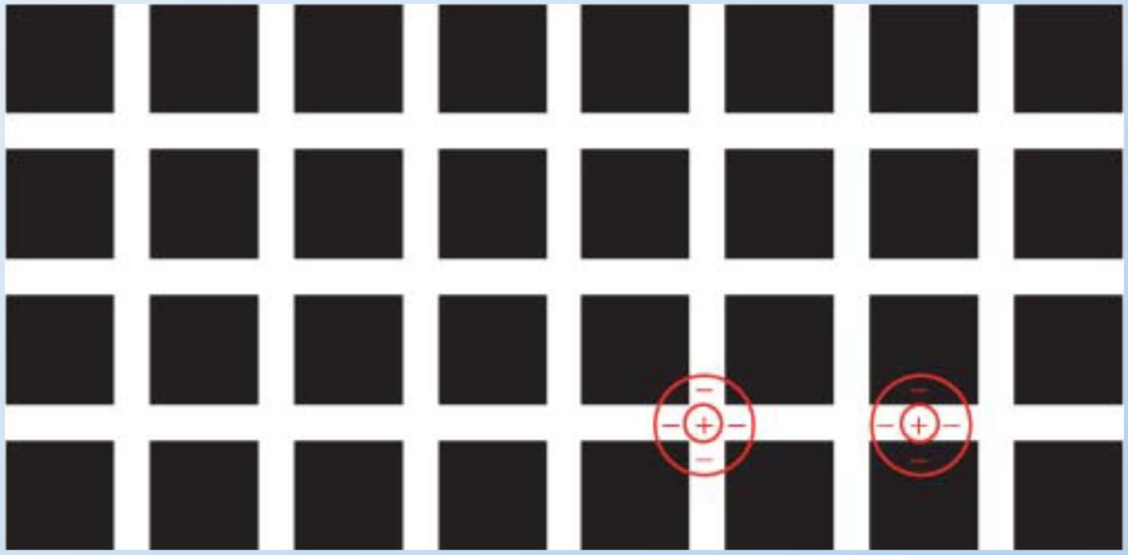


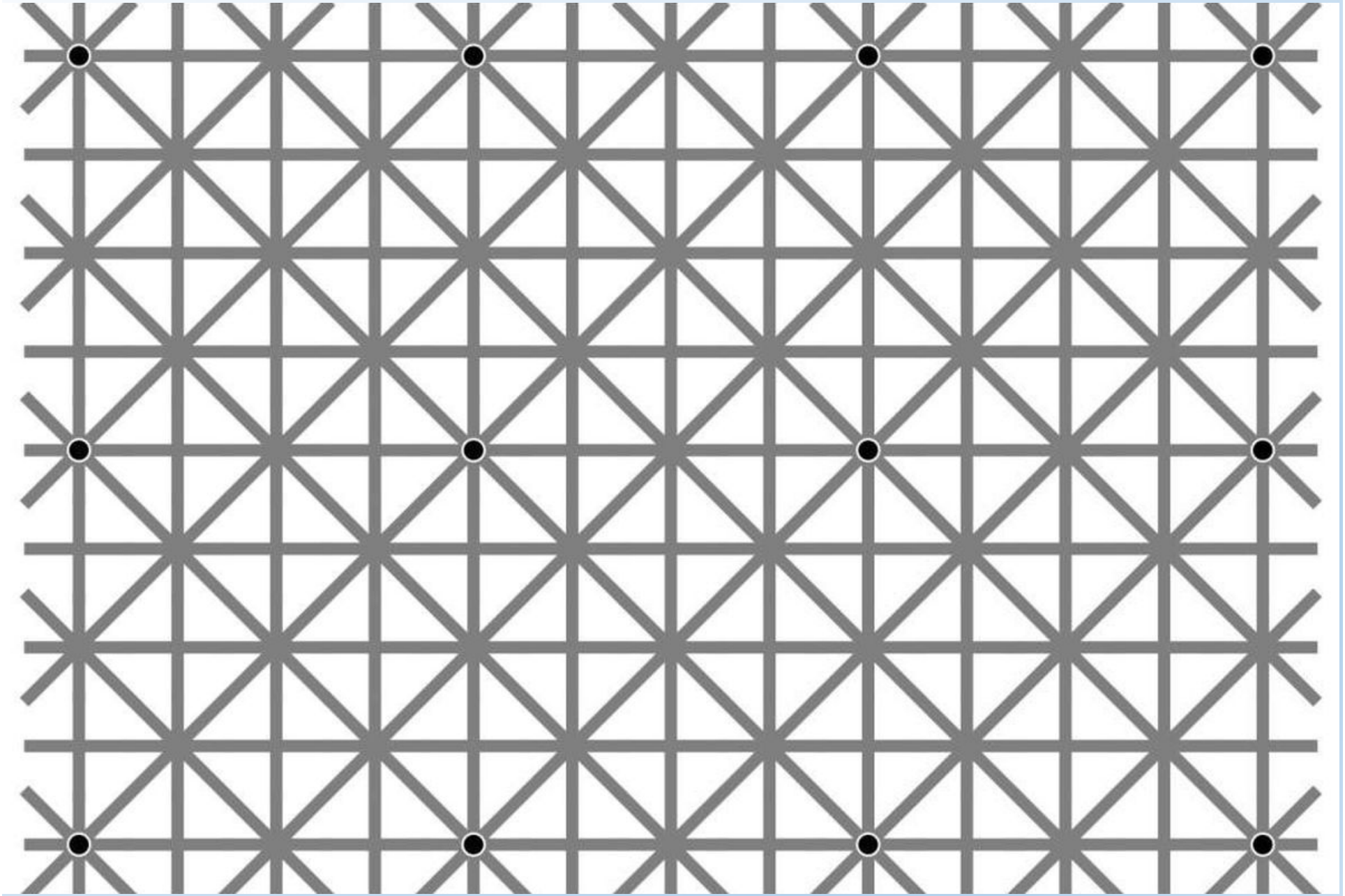


Value Shift:
This kelly green color changes its value with complememtary colors behind itself. The lime green behind it makes the kelly green appear darker. The deep red makes the kelly green appear lighter.

Saturation Shift:
The coral pink color shifts and appears more saturated when it is in front of its complenmentary color. The coral desaturates when its placed in front of an analogous color.

Hermann grid





Objectivist view (“blank slate”view)

Our senses precisely, and accurately, reflect the physical world. They provide us with a true, complete, and accurate representation.

Subjectivist view (Gestalt)

There is no inherent organization to the world, but rather, our brain organizes our perceptions, and we therefore believe the world is, itself, organized.

Synthetic view

The world appears to us the way it does because:

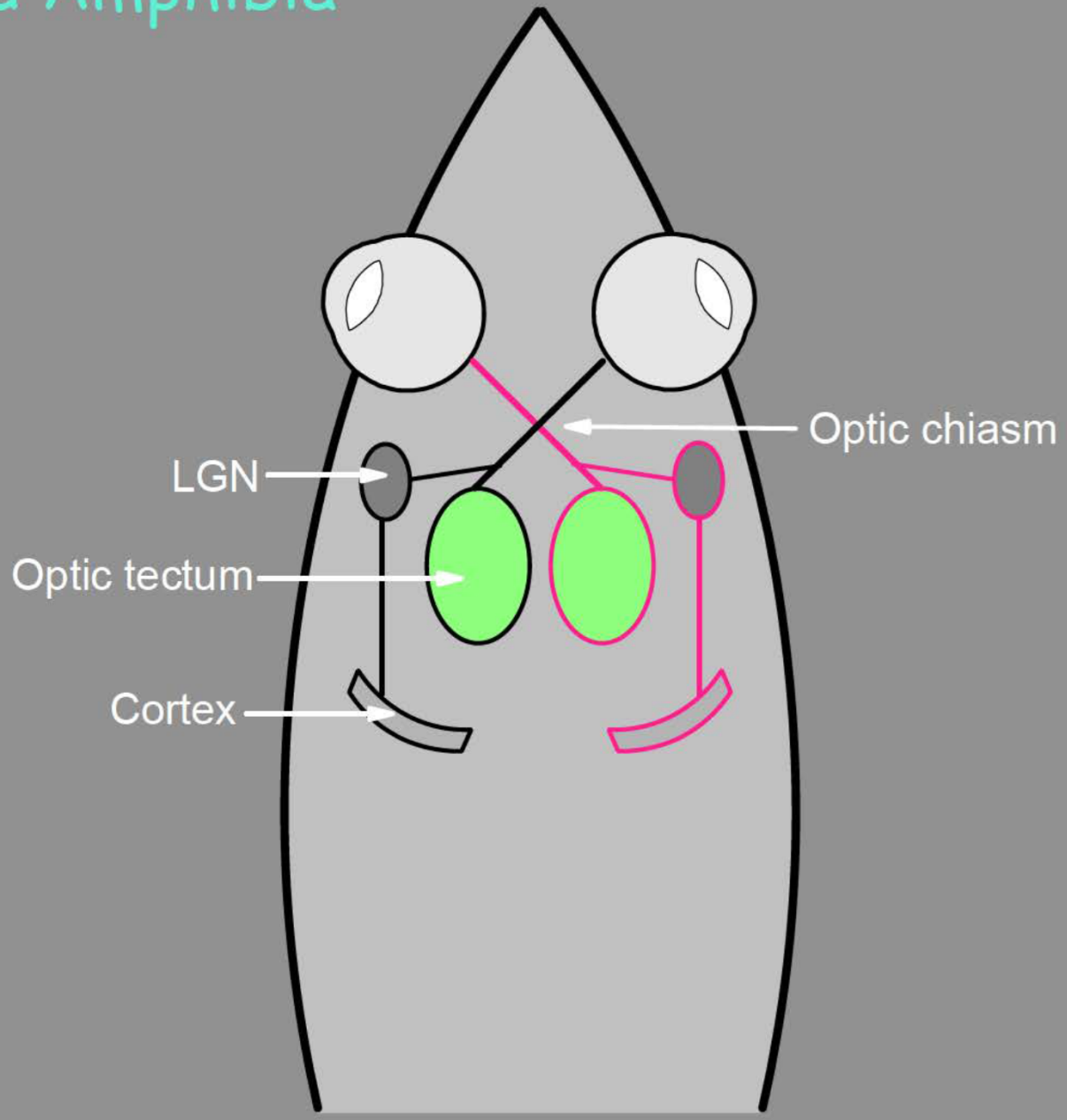
(1) We perceive only within the limits of our nervous system

(2) Our nervous system has evolved to reflect portions of the world very accurately.

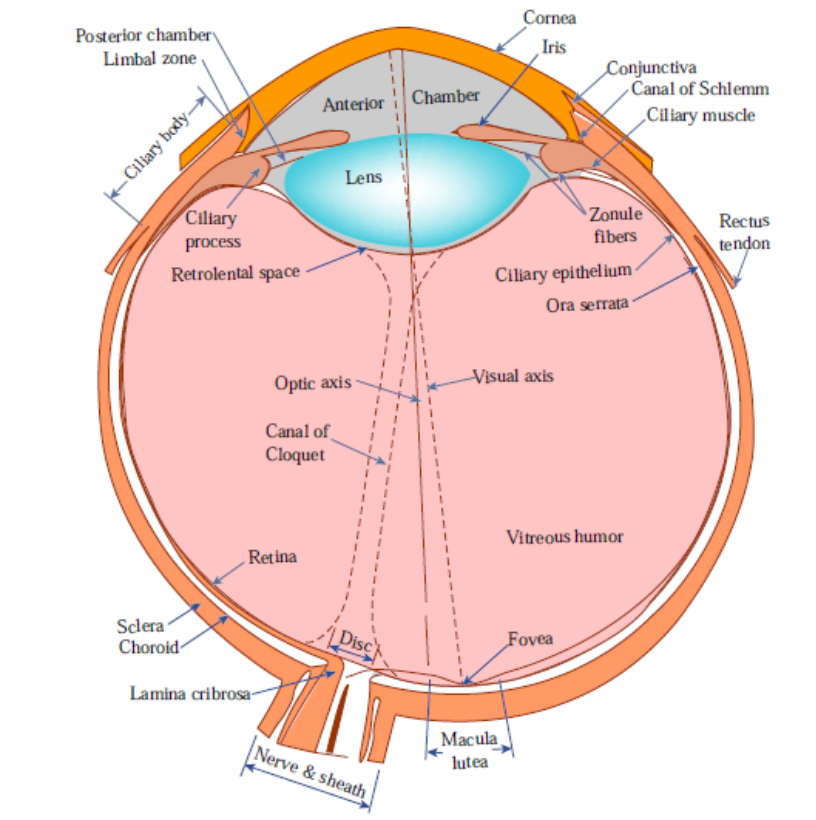
本课程里

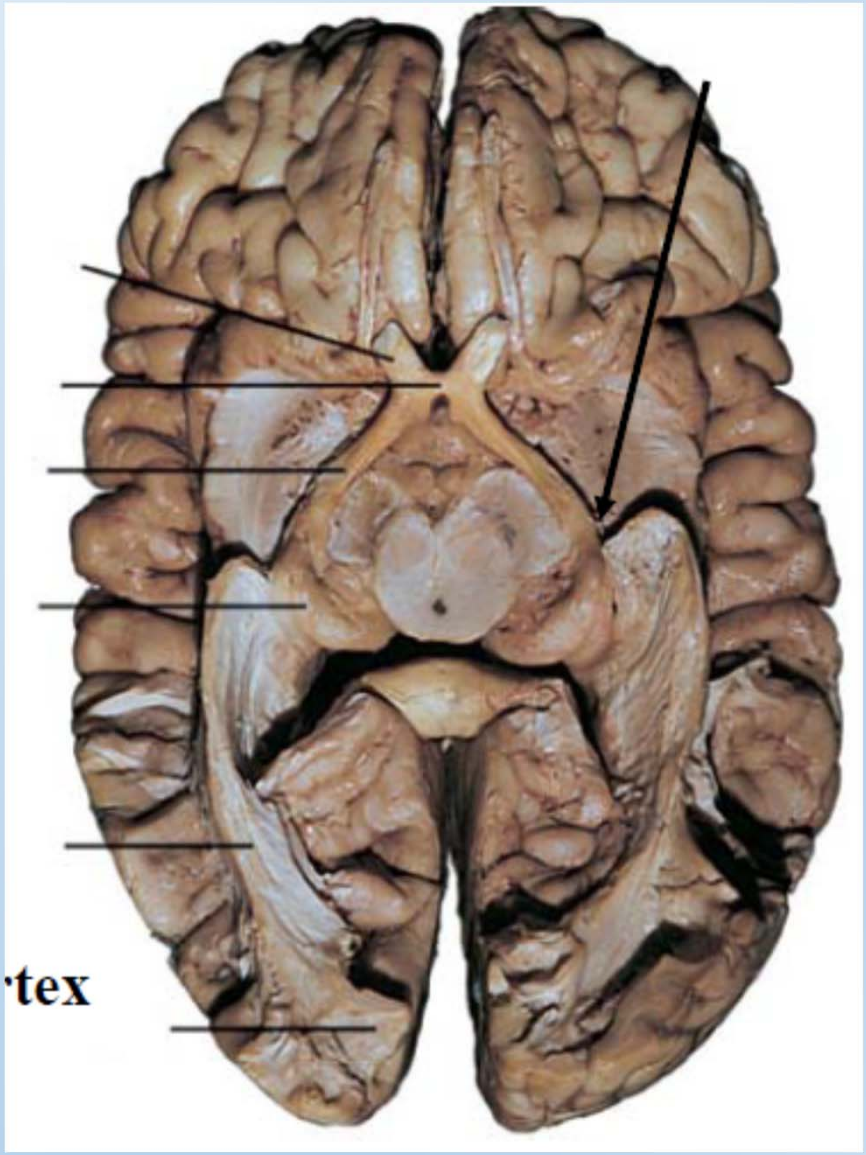
- 1. 视觉的生理结构
- 2. 视觉系统的运作方式
- 3. 特殊情形

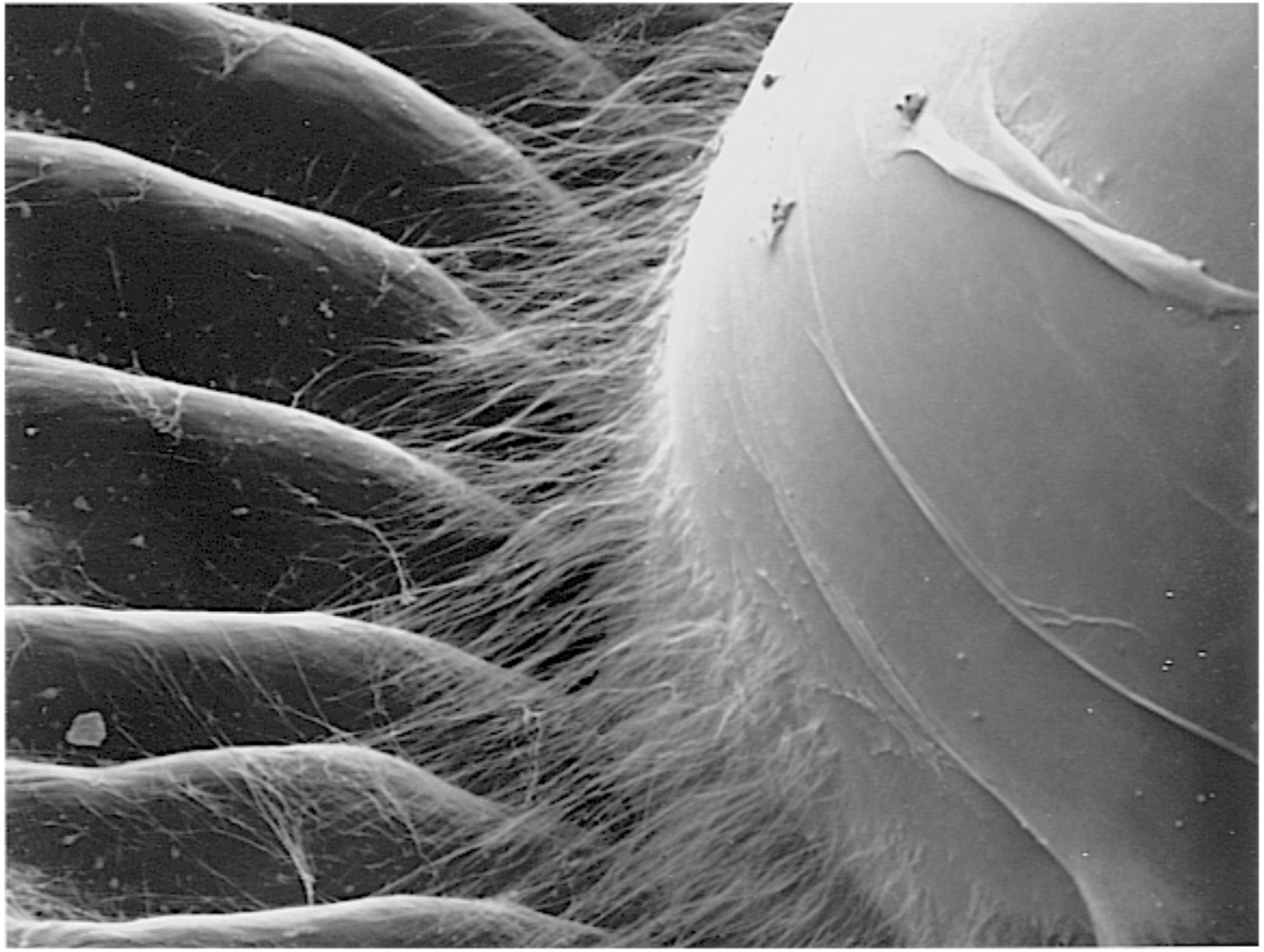
Fish and Amphibia

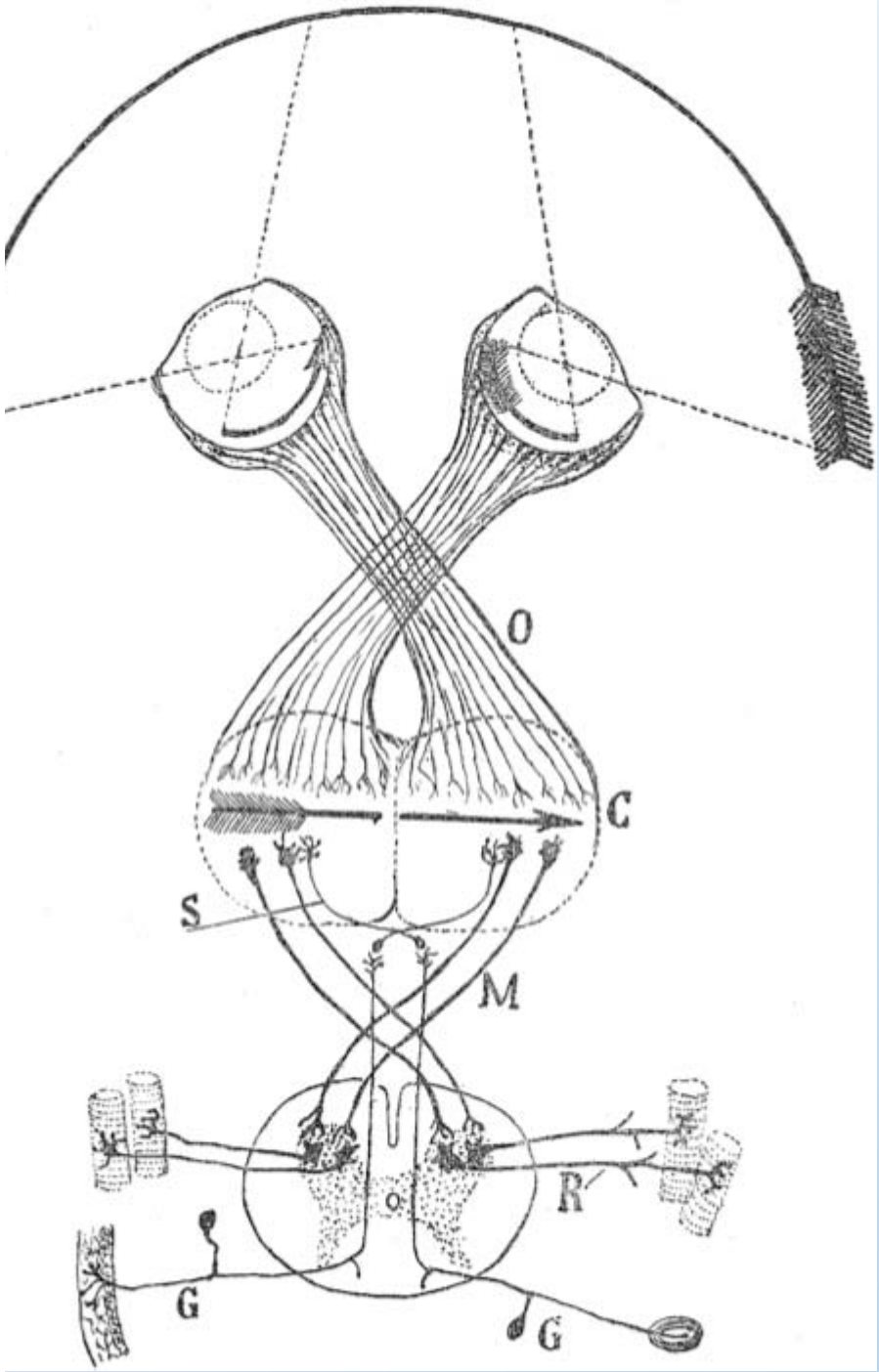


视觉系统


Posterior chamber
Limbal zone
Ciliary body
Cornea
Iris
Conjunctiva
Canal of Schlemm
Ciliary muscle
Anterior
Chamber
Lens
Ciliary process
Zonule fibers
Rectus tendon
Retrolental space
Ciliary epithelium
Ora serrata
Optic axis
Visual axis
Canal of Cloquet
Vitreous humor
Retina
Sclera
Choroid
Disc
Fovea
Lamina cribrosa
Macula lutea
Nerve & sheath


tex



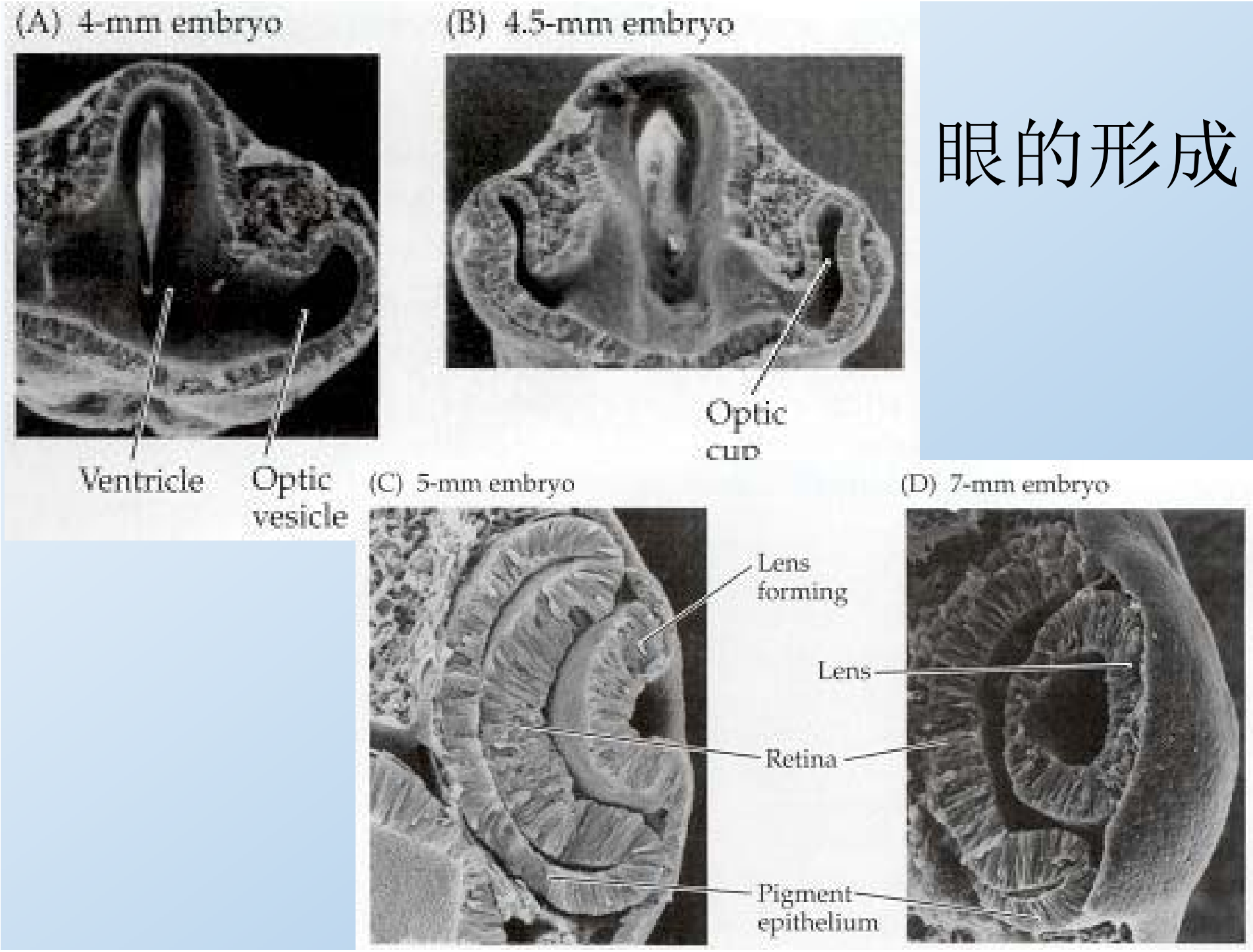


基本结构

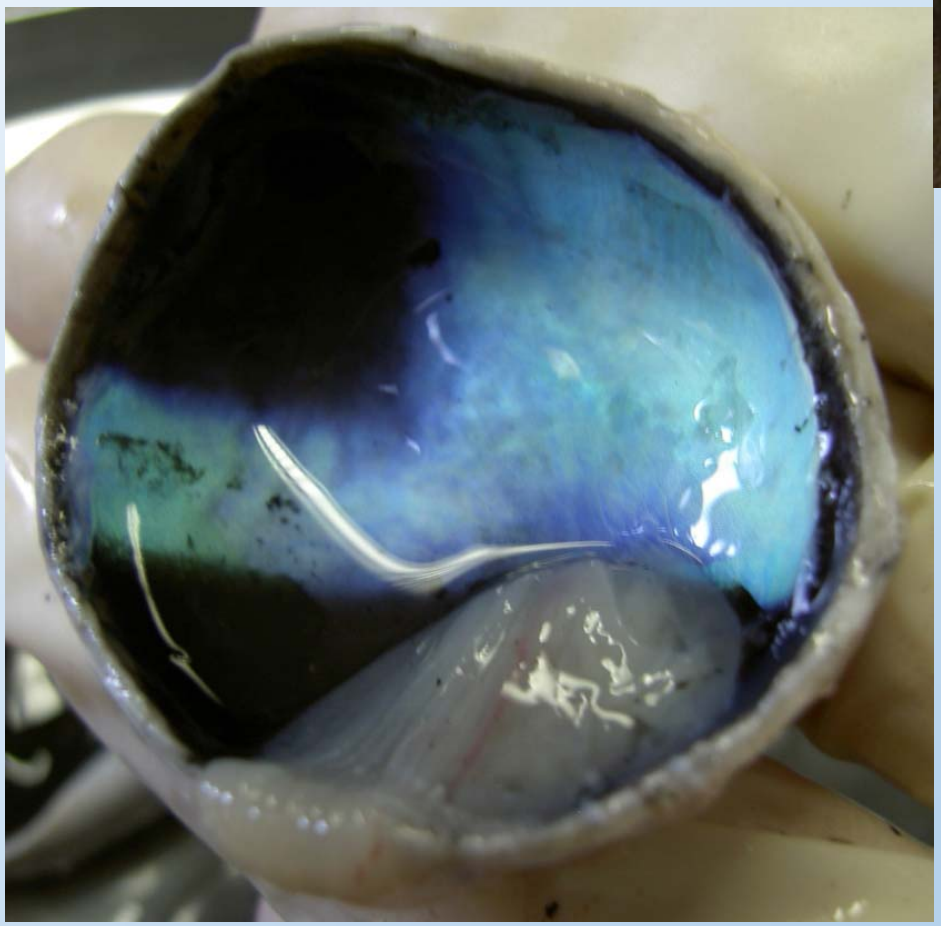
Decussation：

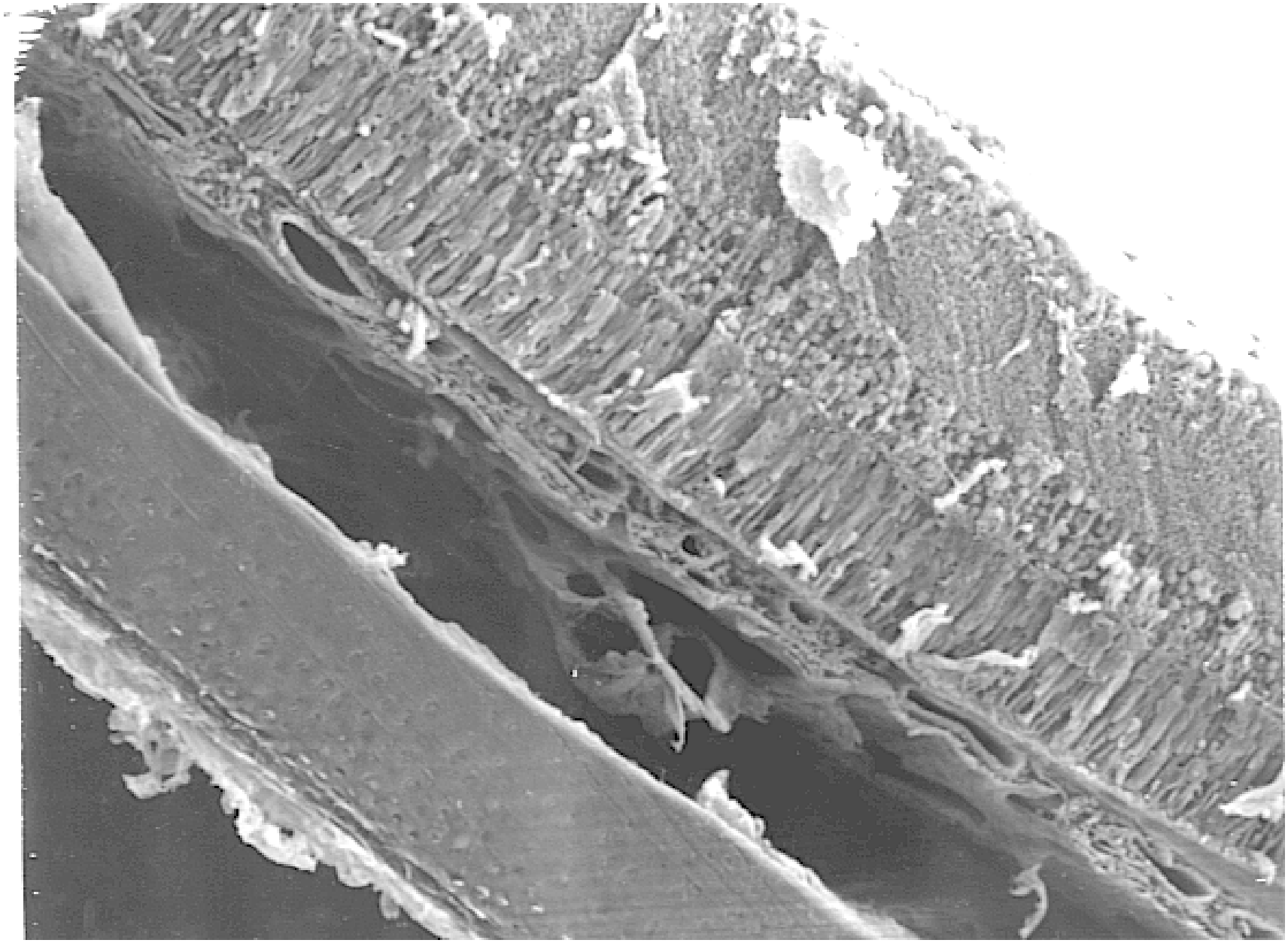
de Lussanet, M.H.E.; Osse, J.W.M. (2012). "An ancestral axial twist explains the contralateral forebain and the optic chiasm in vertebrates". Animal Biology. 62: 193－216

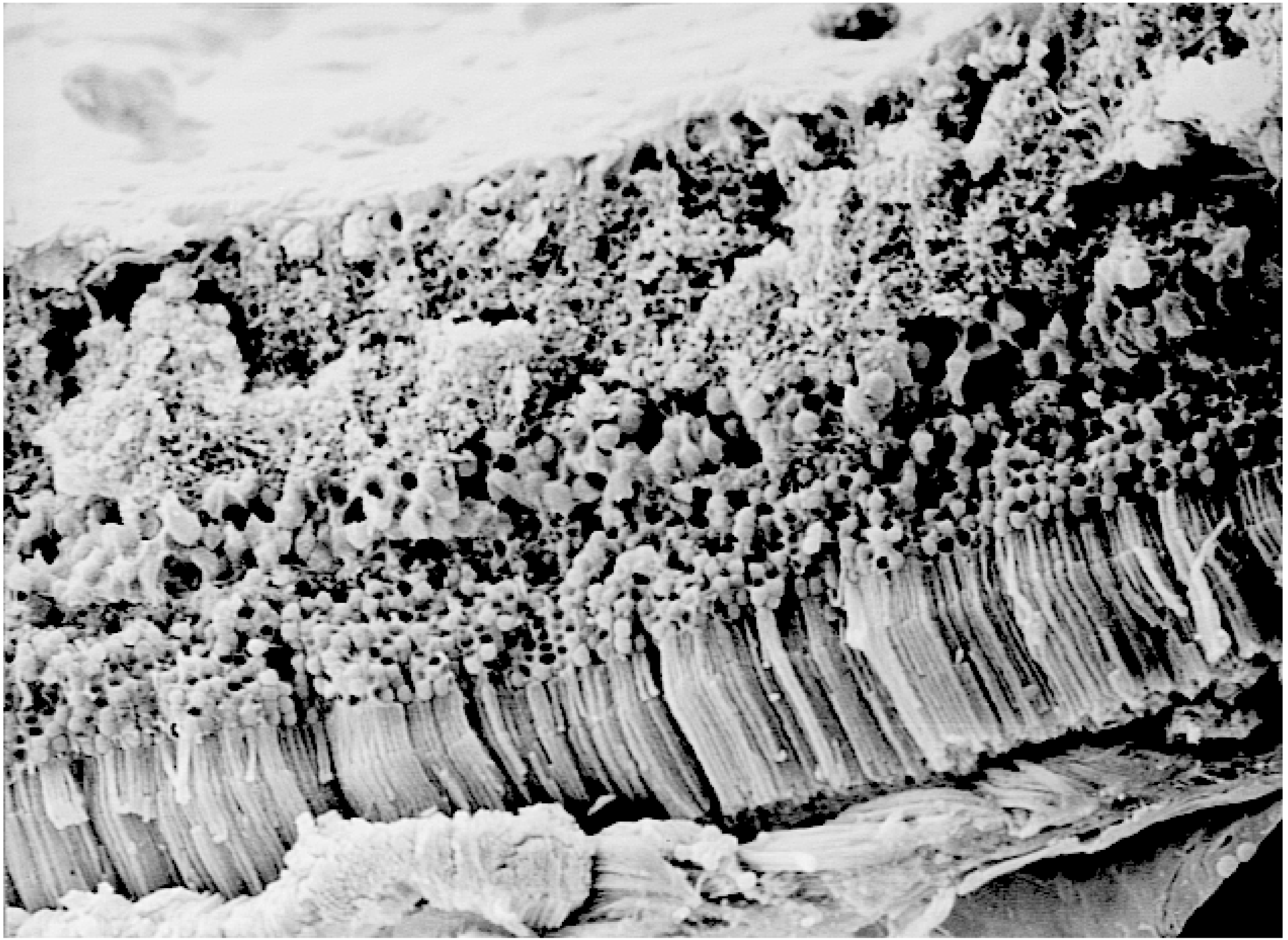
眼的形成


(A) 4-mm embryo
(B) 4.5-mm embryo
Ventricle
Optic vesicle
Optic cup
(C) 5-mm embryo
(D) 7-mm embryo
Lens forming
Lens
Retina
Pigment epithelium

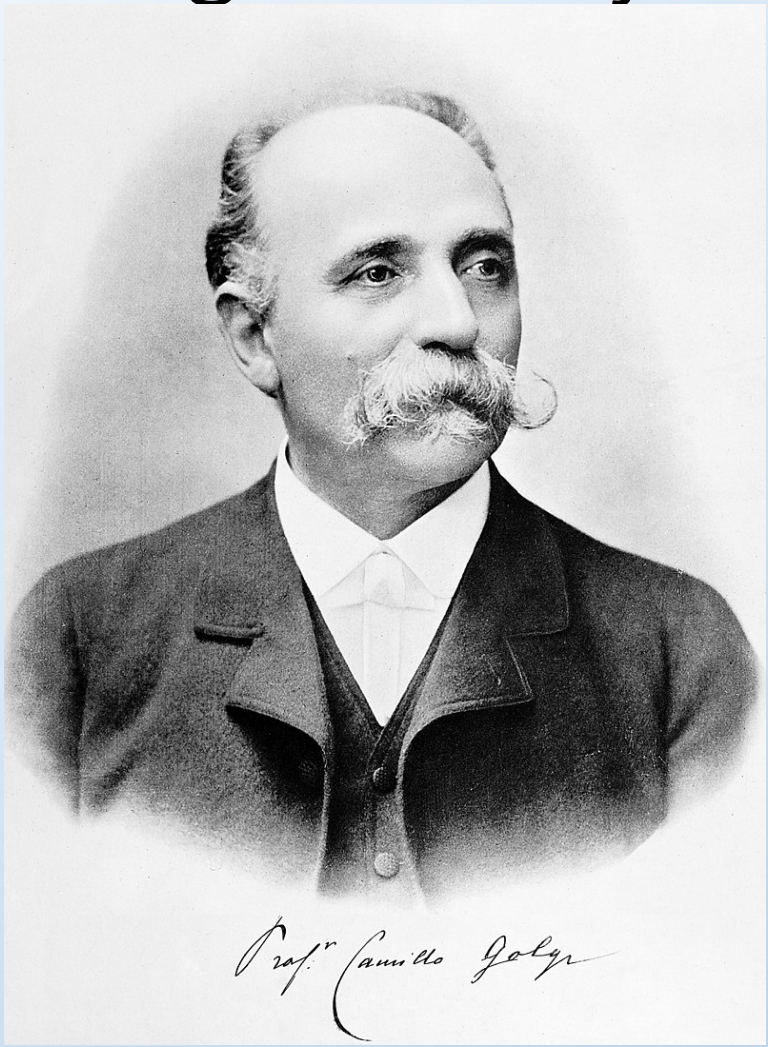
细微结构



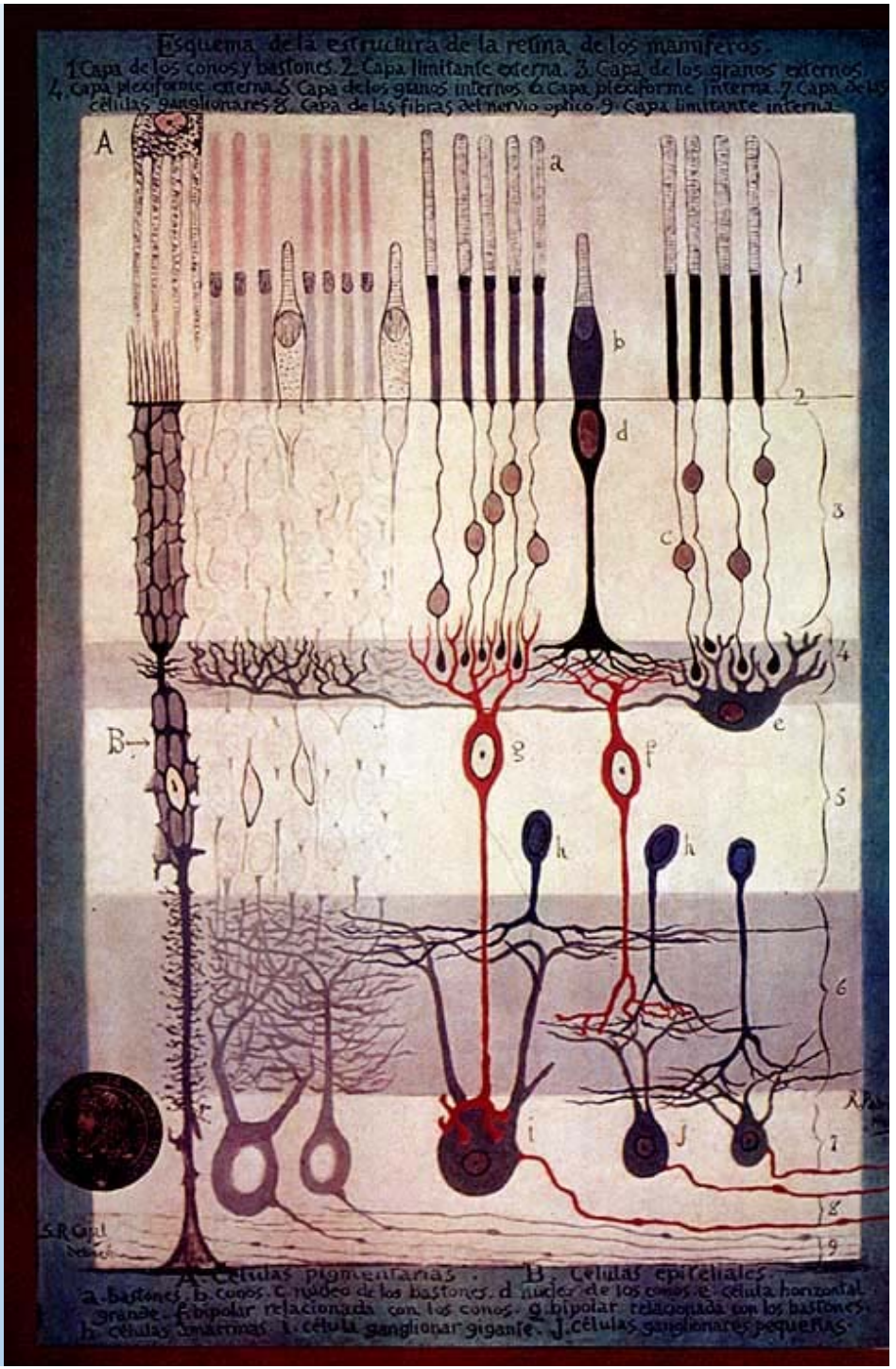


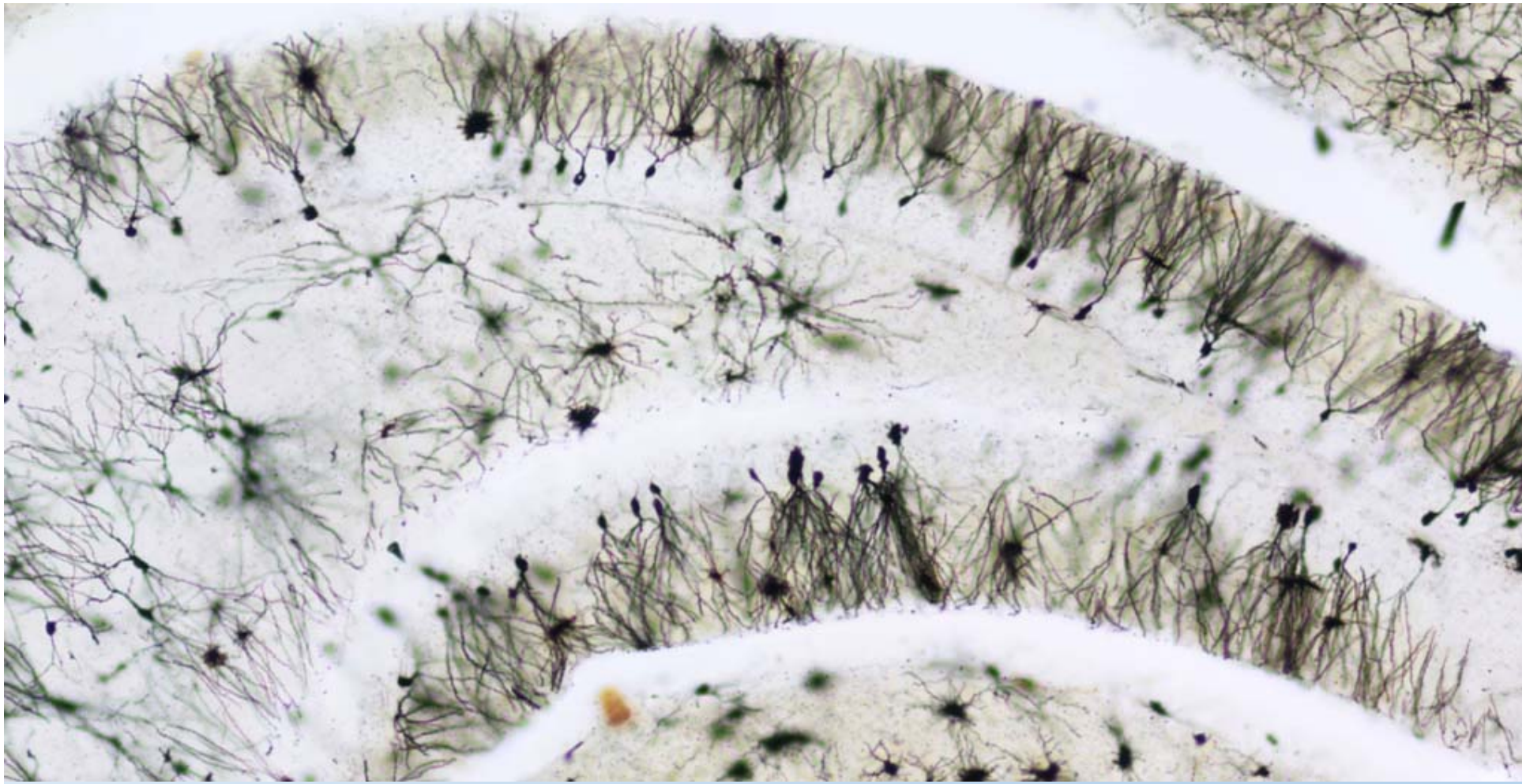


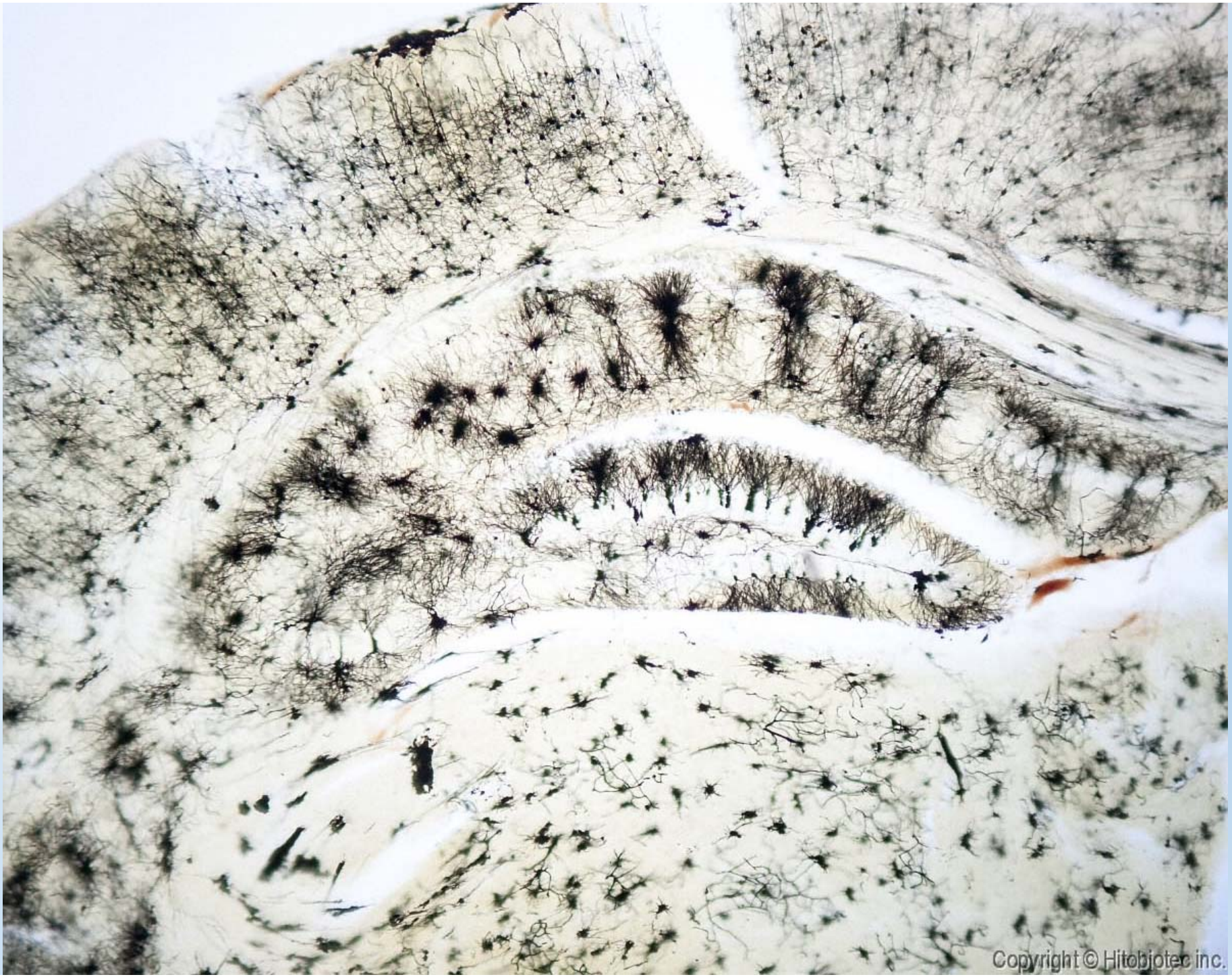
Golgi and Cajal

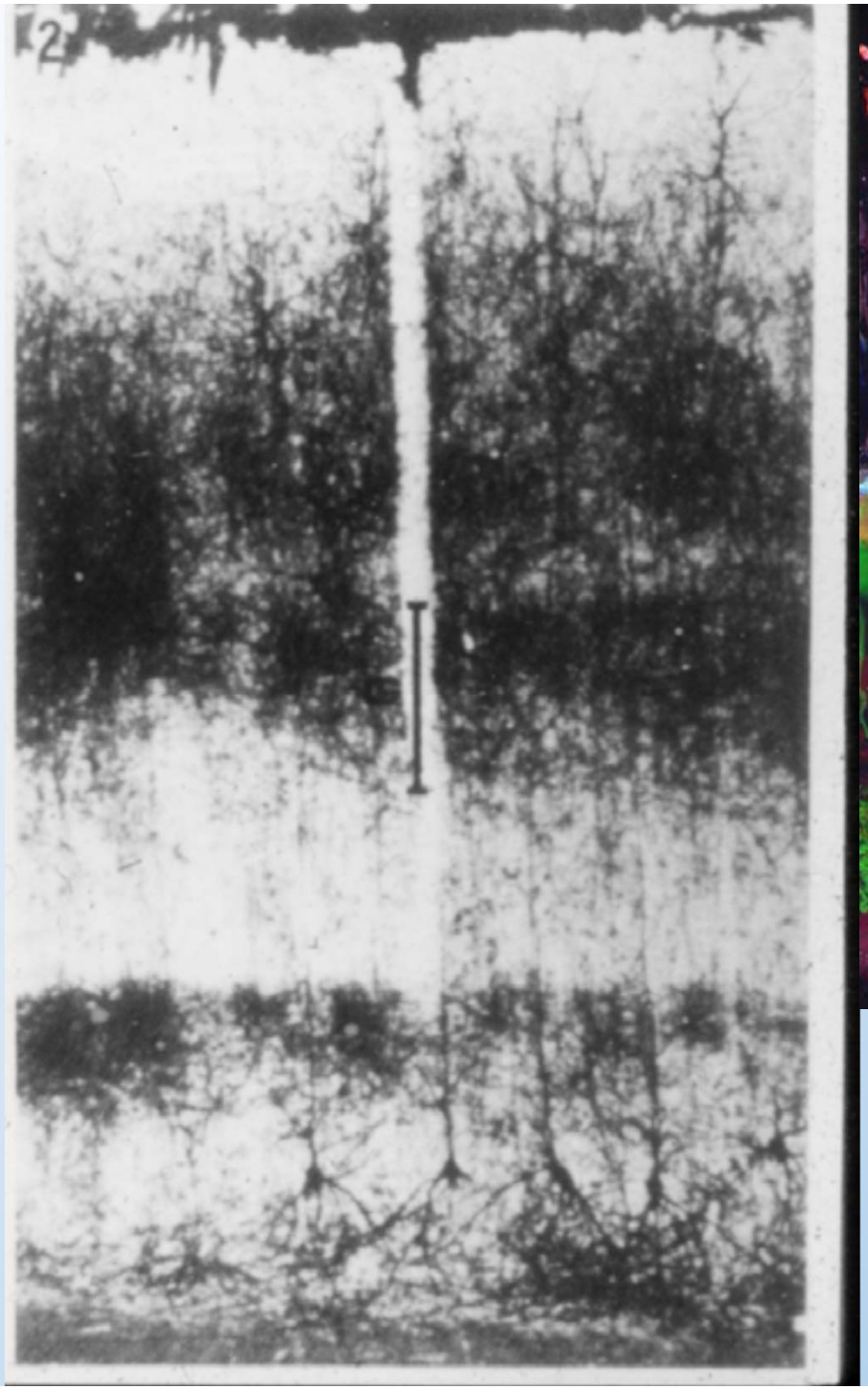


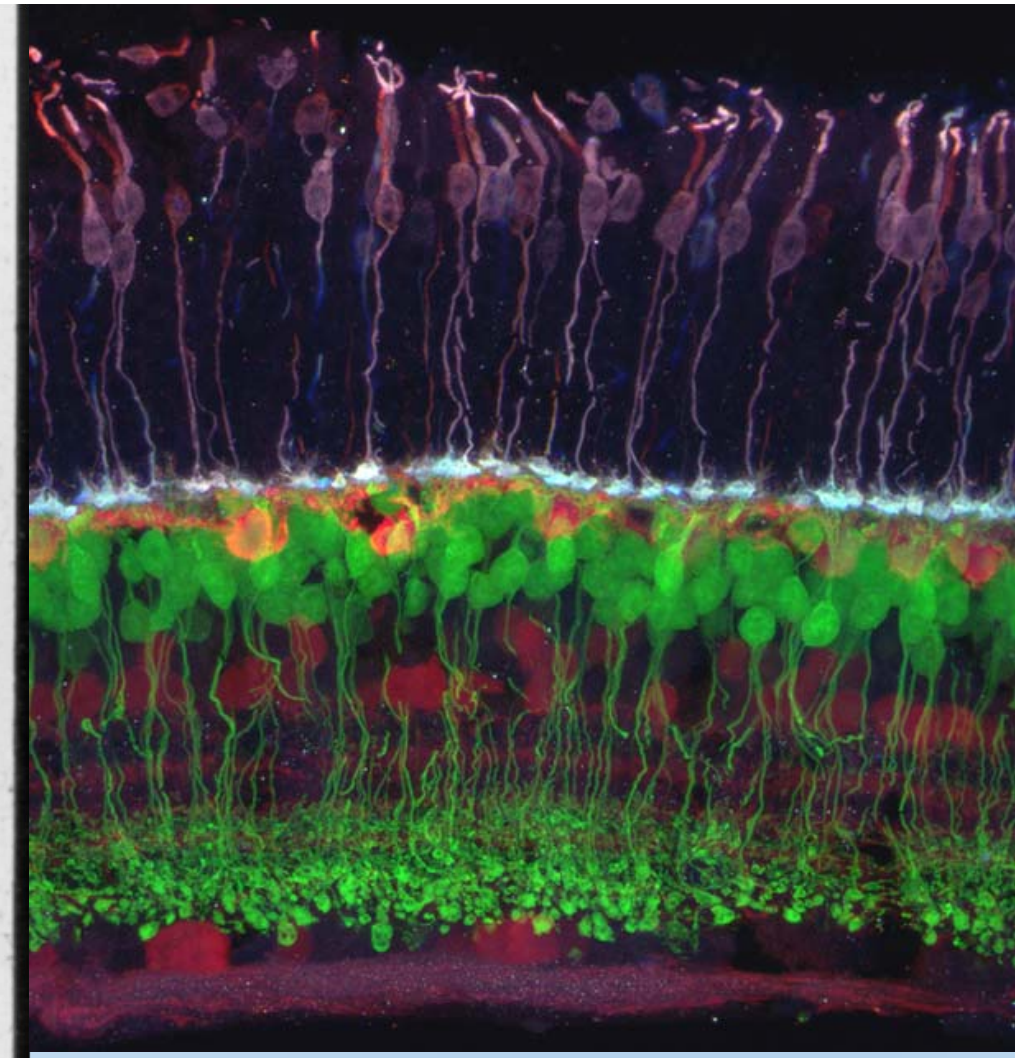
1843-1926, Nobel laureate1906



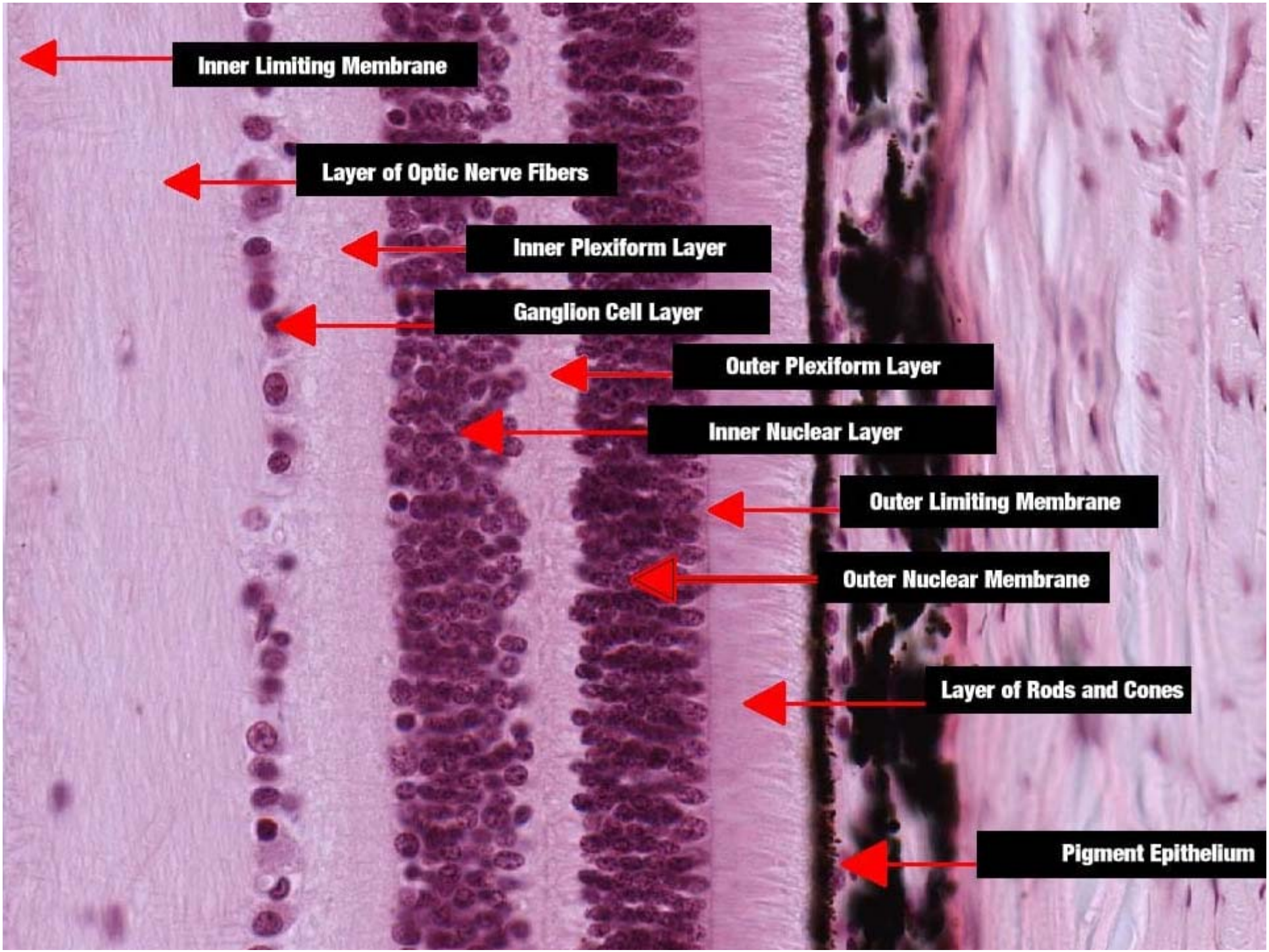


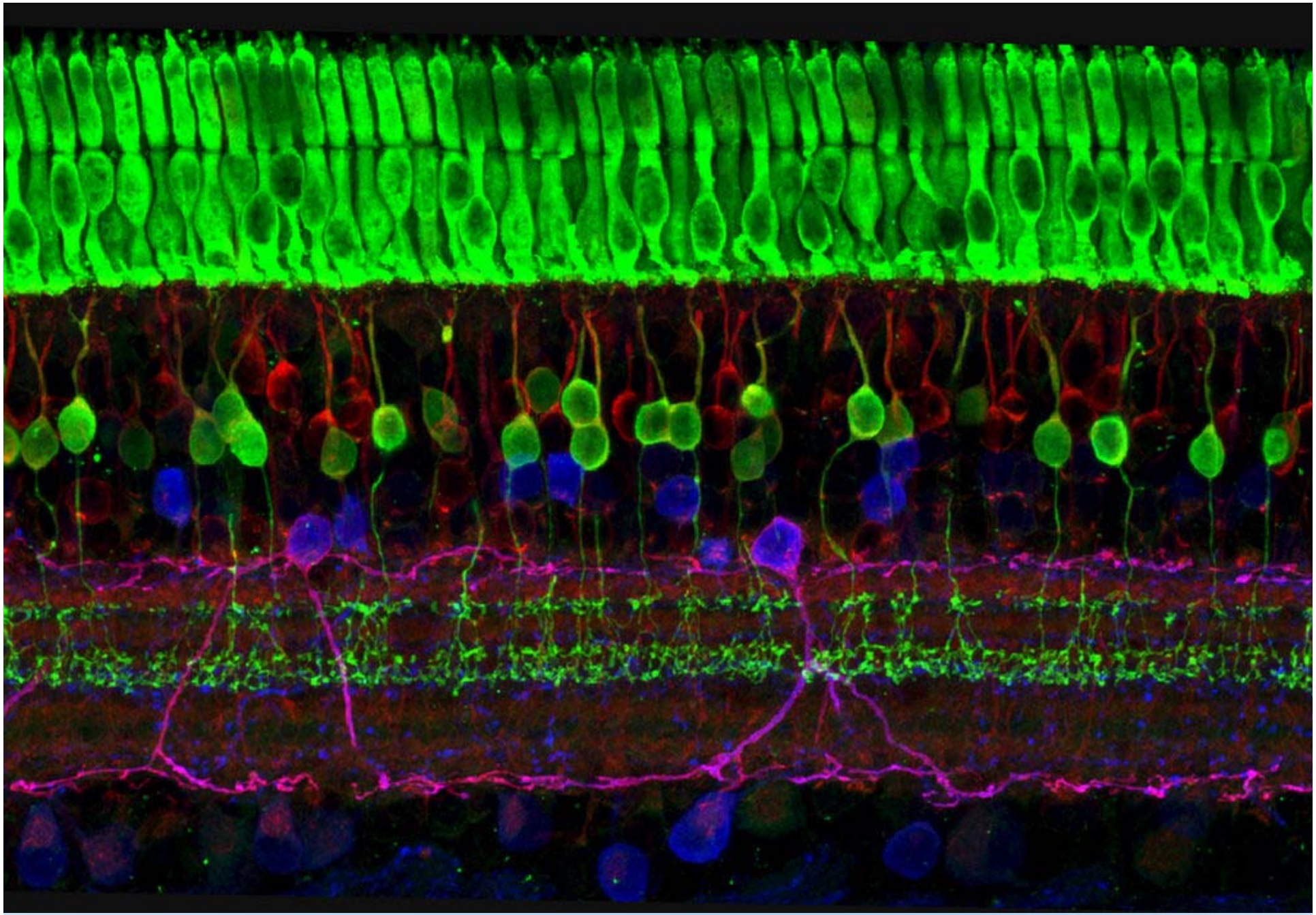

Copyright © Hitobjotec inc.

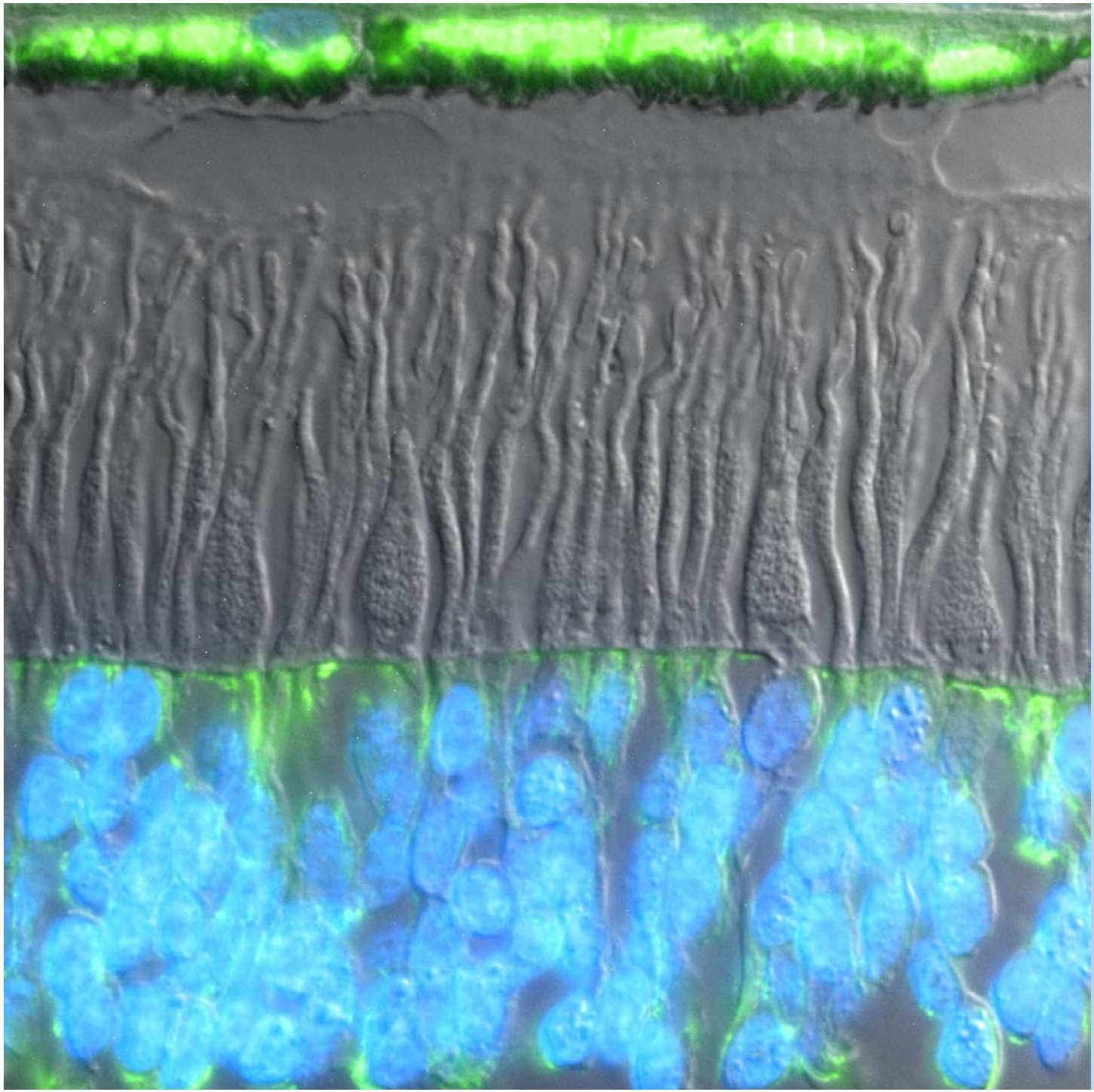




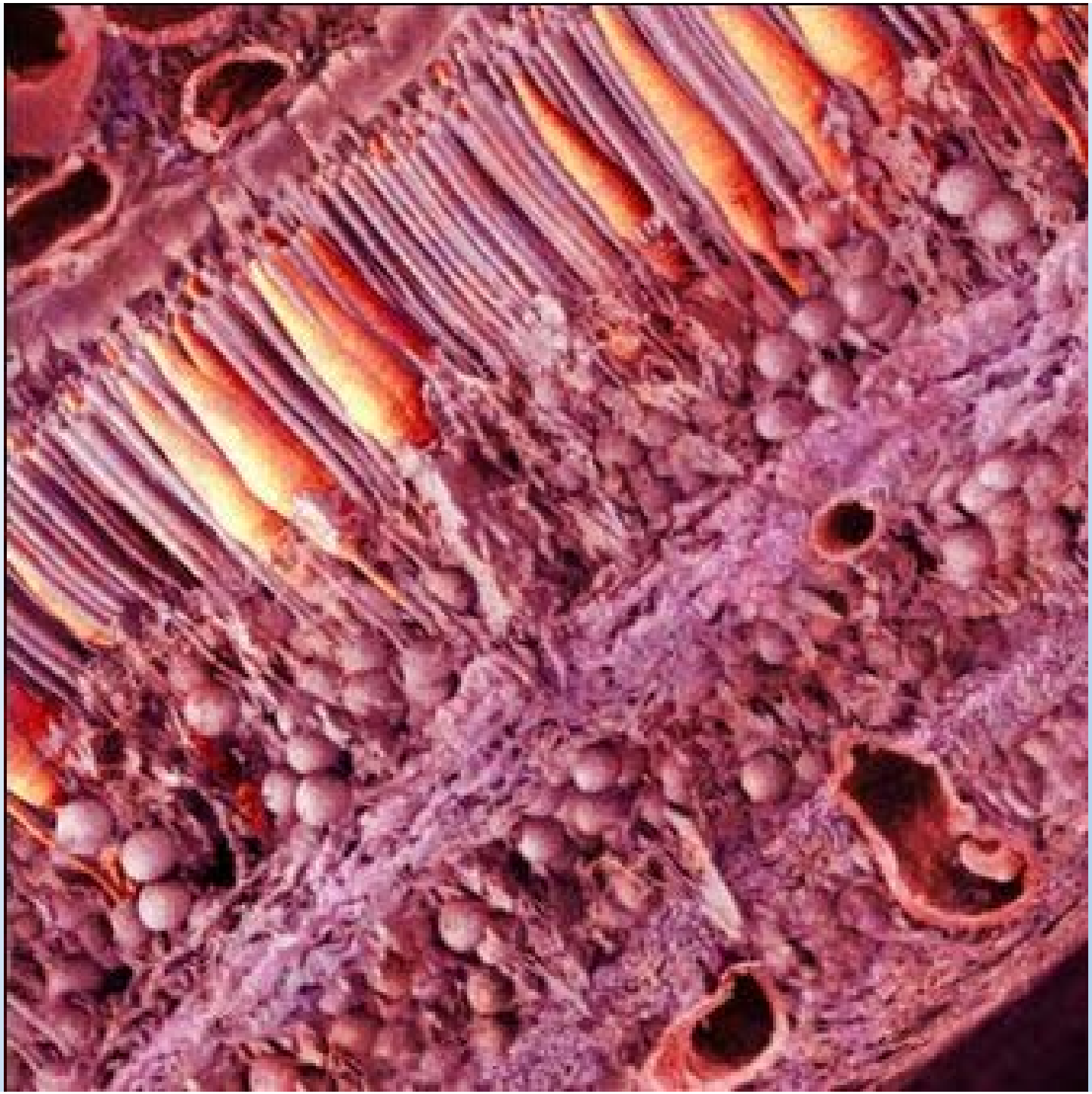
视网膜的细微结构

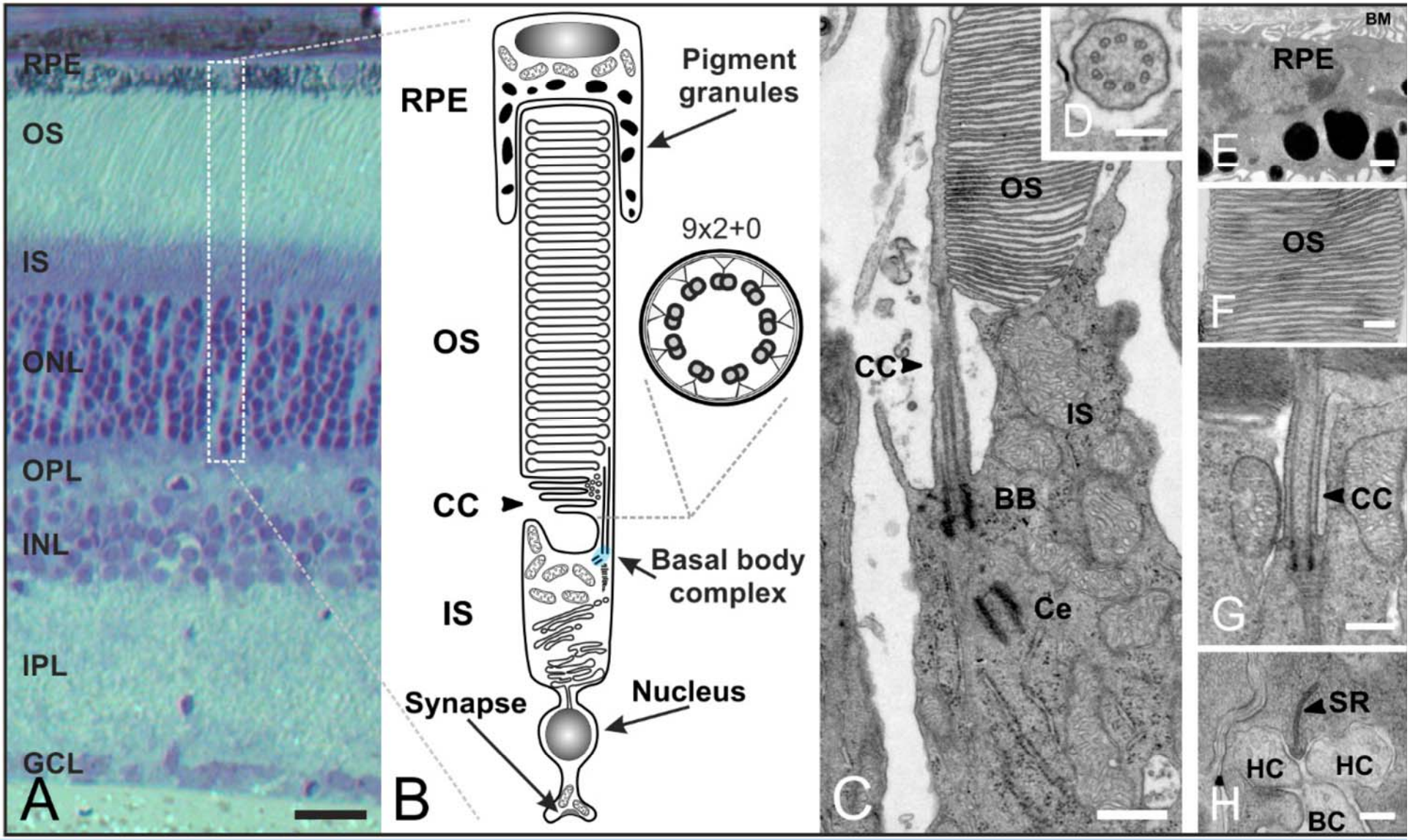

Inner Limiting Membrane
Layer of Optic Nerve Fibers
Inner Plexiform Layer
Ganglion Cell Layer
Outer Plexiform Layer
Inner Nuclear Layer
Outer Limiting Membrane
Outer Nuclear Membrane
Layer of Rods and Cones
Pigment Epithelium

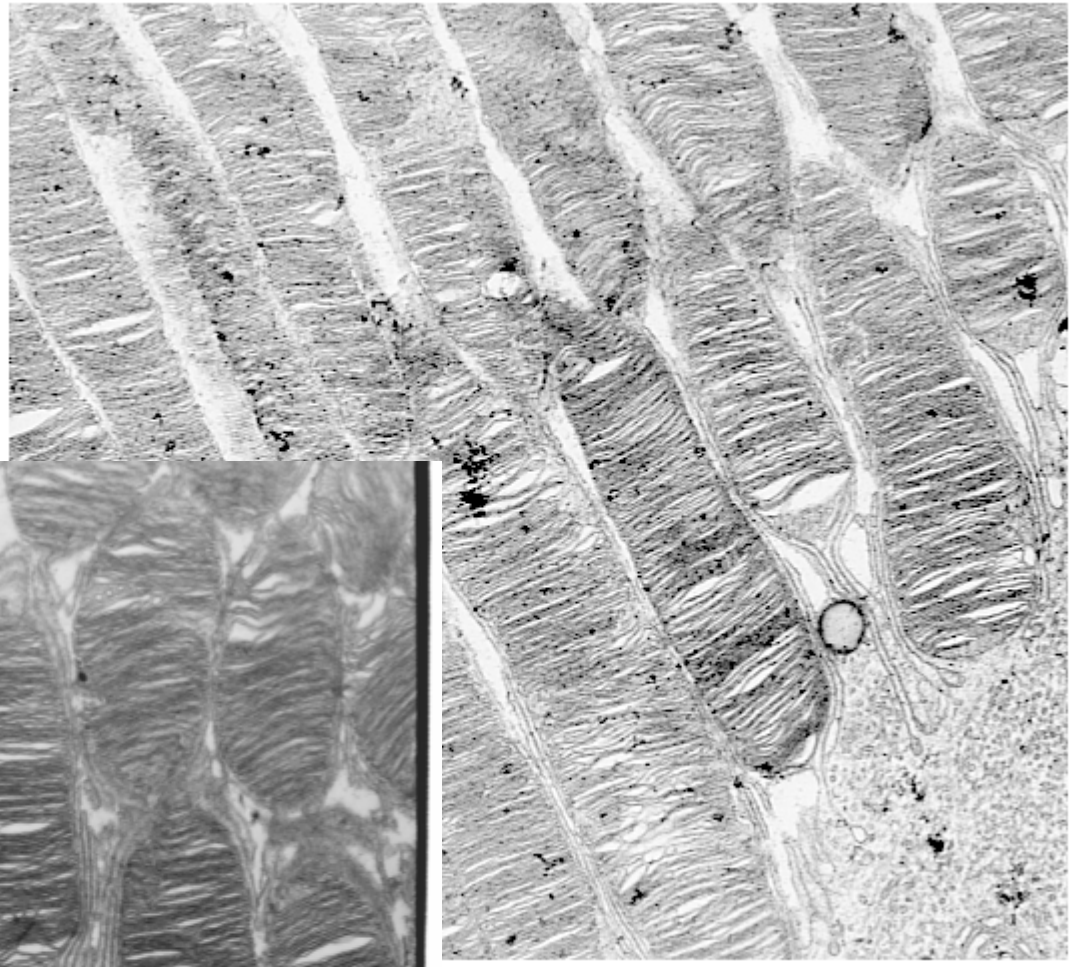


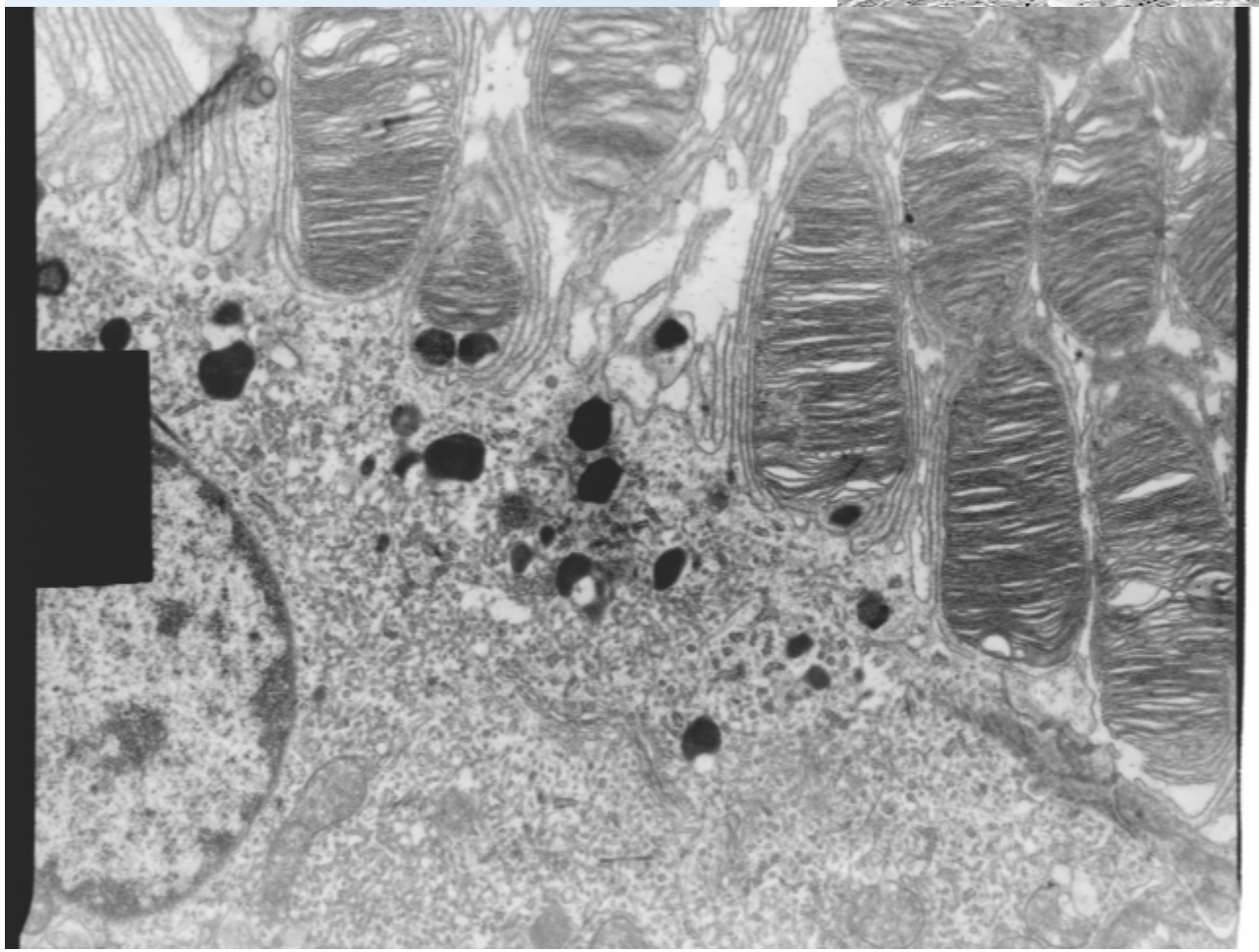


Rods
and
Corns

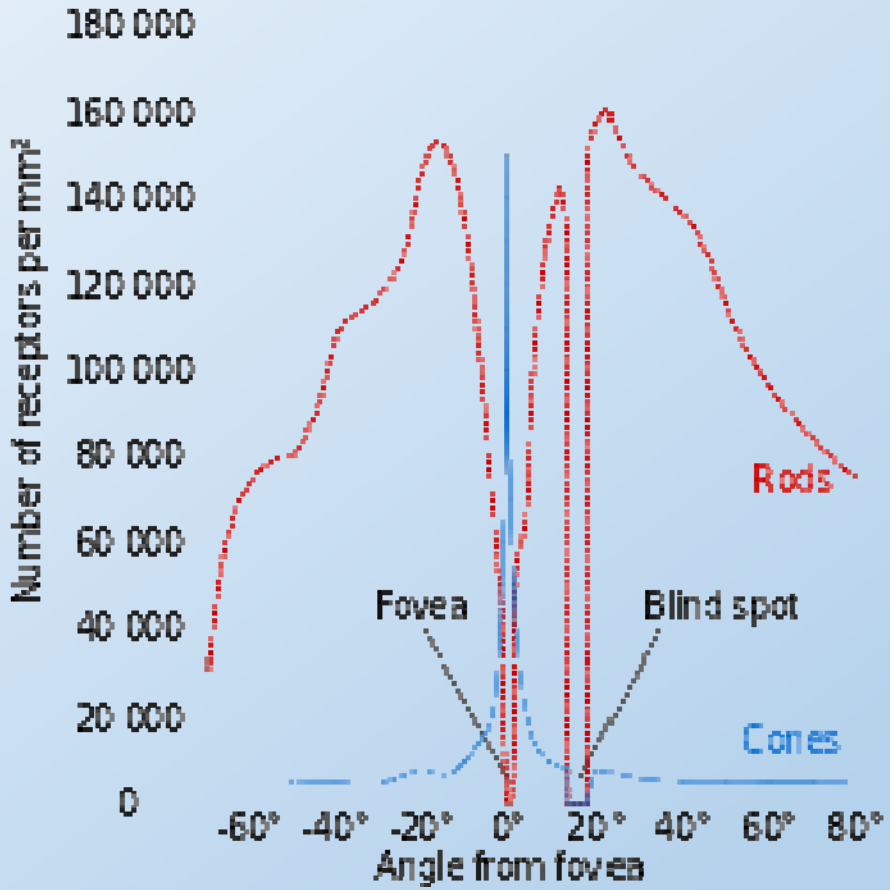


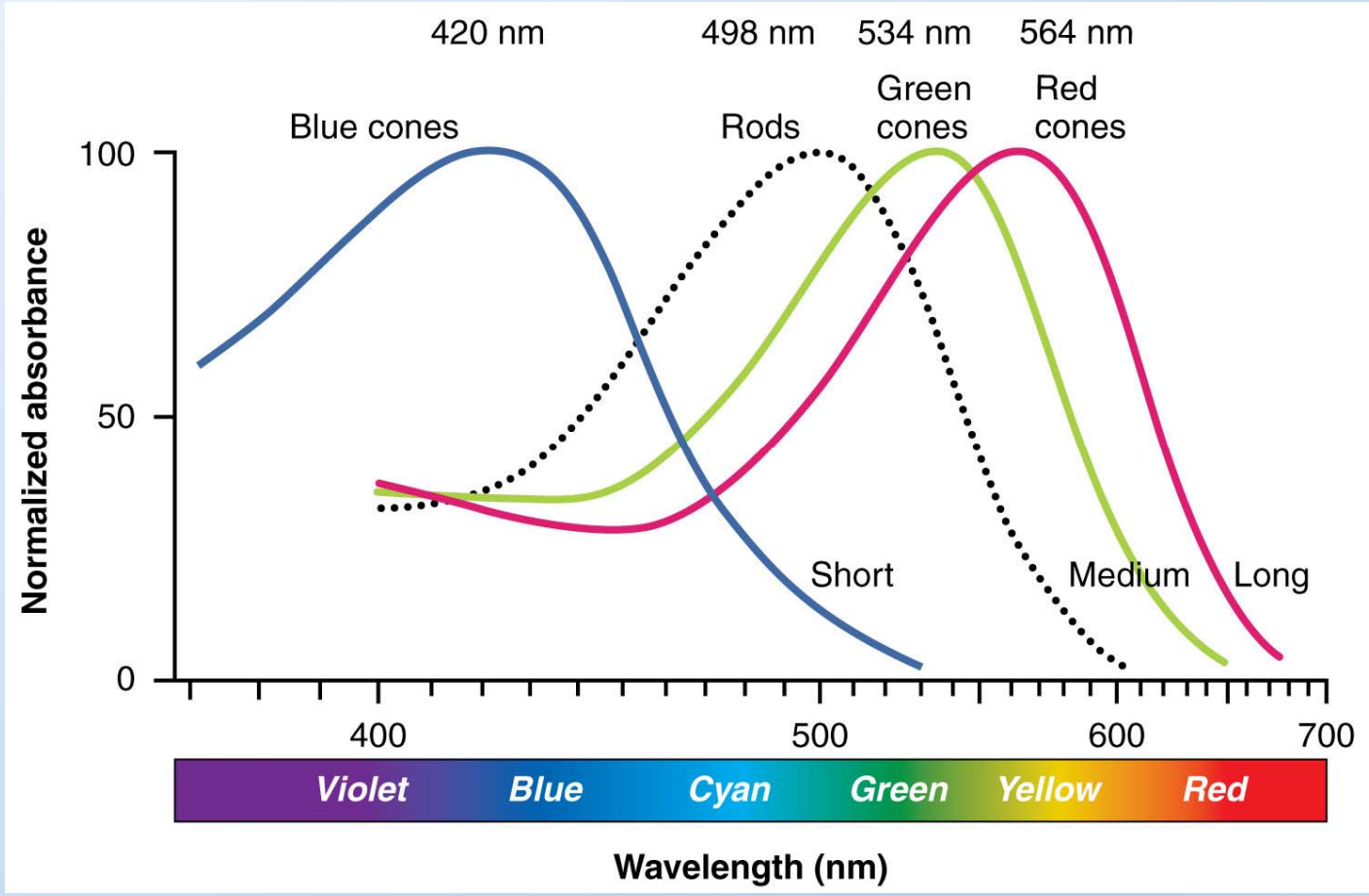

RPE
OS
IS
ONL
OPL
INL
IPL
GCL
A
RPE
Pigment granules
9x2+0
OS
CC
IS
Basal body complex
Synapse
Nucleus
B
OS
CC
IS
BB
Ce
C
D
BM
RPE
E
OS
F
CC
G
SR
HC
HC
BC
H

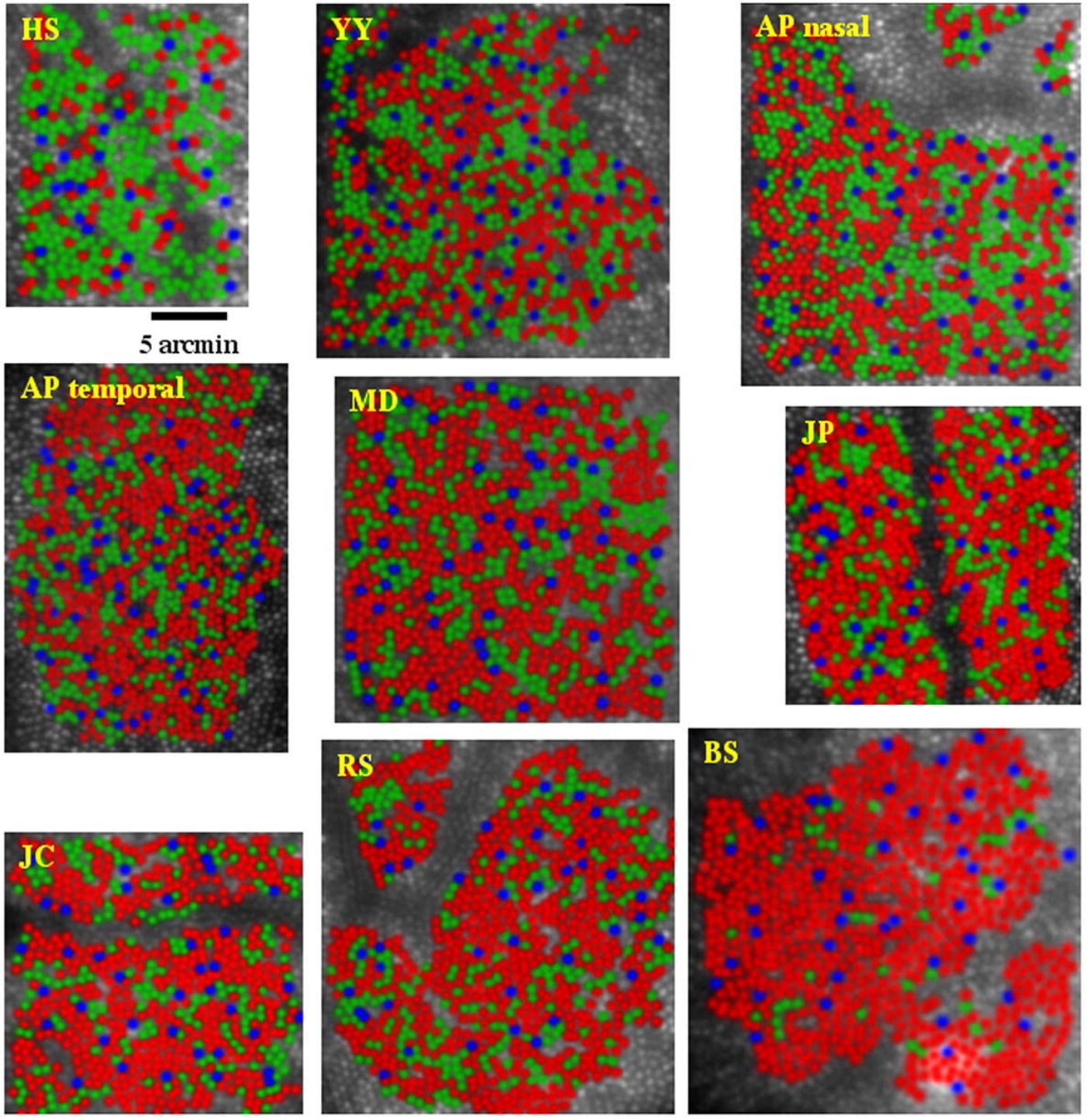




分布

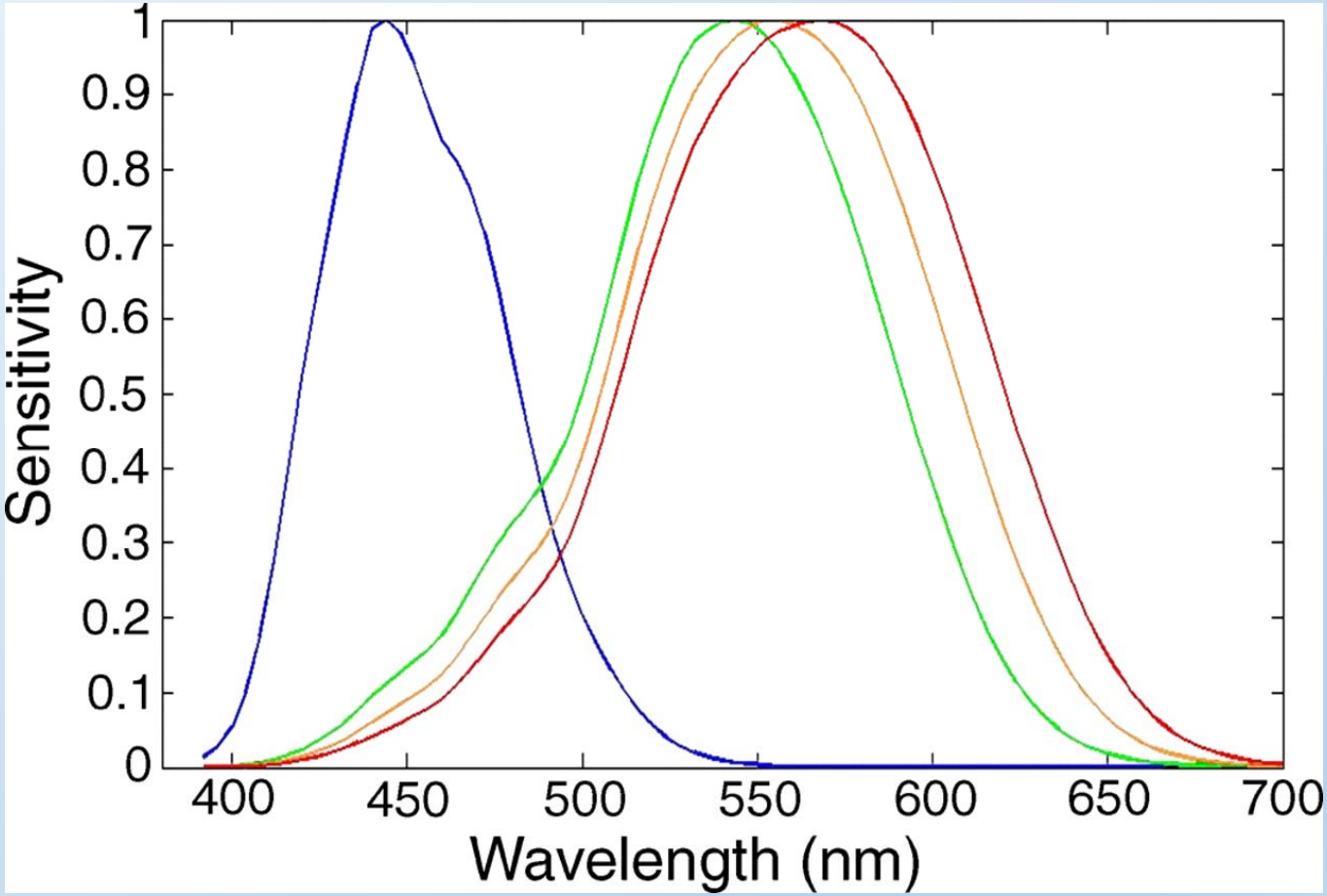

180 000
160 000
140 000
120 000
100 000
80 000
60 000
40 000
20 000
0
Number of receptors per mm²
Rods
Fovea
Blind spot
Cones
-60°
-40°
-20°
0°
20°
40°
60°
80°
Angle from fovea


420 nm
498 nm
534 nm
564 nm
Blue cones
Rods
Green cones
Red cones
100
50
0
Normalized absorbance
Short
Medium
Long
400
500
600
700
Violet
Blue
Cyan
Green
Yellow
Red
Wavelength (nm)



Organization of the Human Trichromatic Cone Mosaic Journal of Neuroscience 2005, 25 (42) 9669-9679

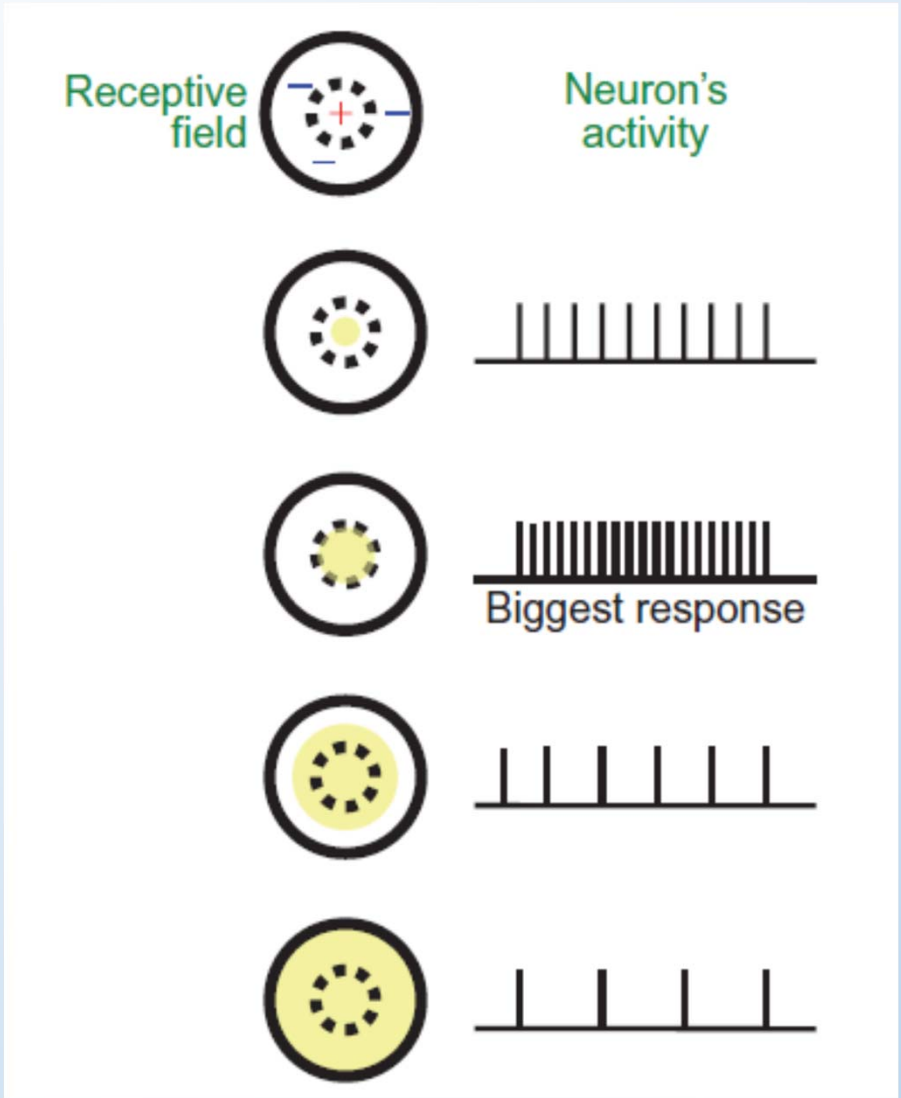
Tetrachromacy

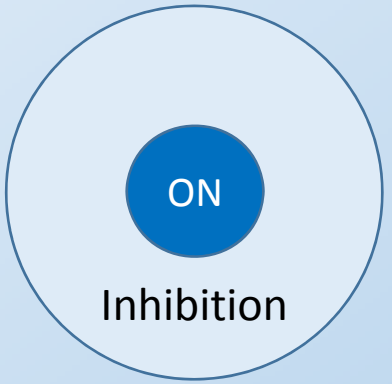


The dimensionality of color vision in carriers of anomalous trichromacy, Journal of Vision 2010;10(8):12.

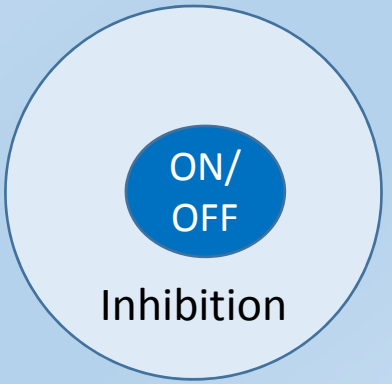
视网膜上的信息处理

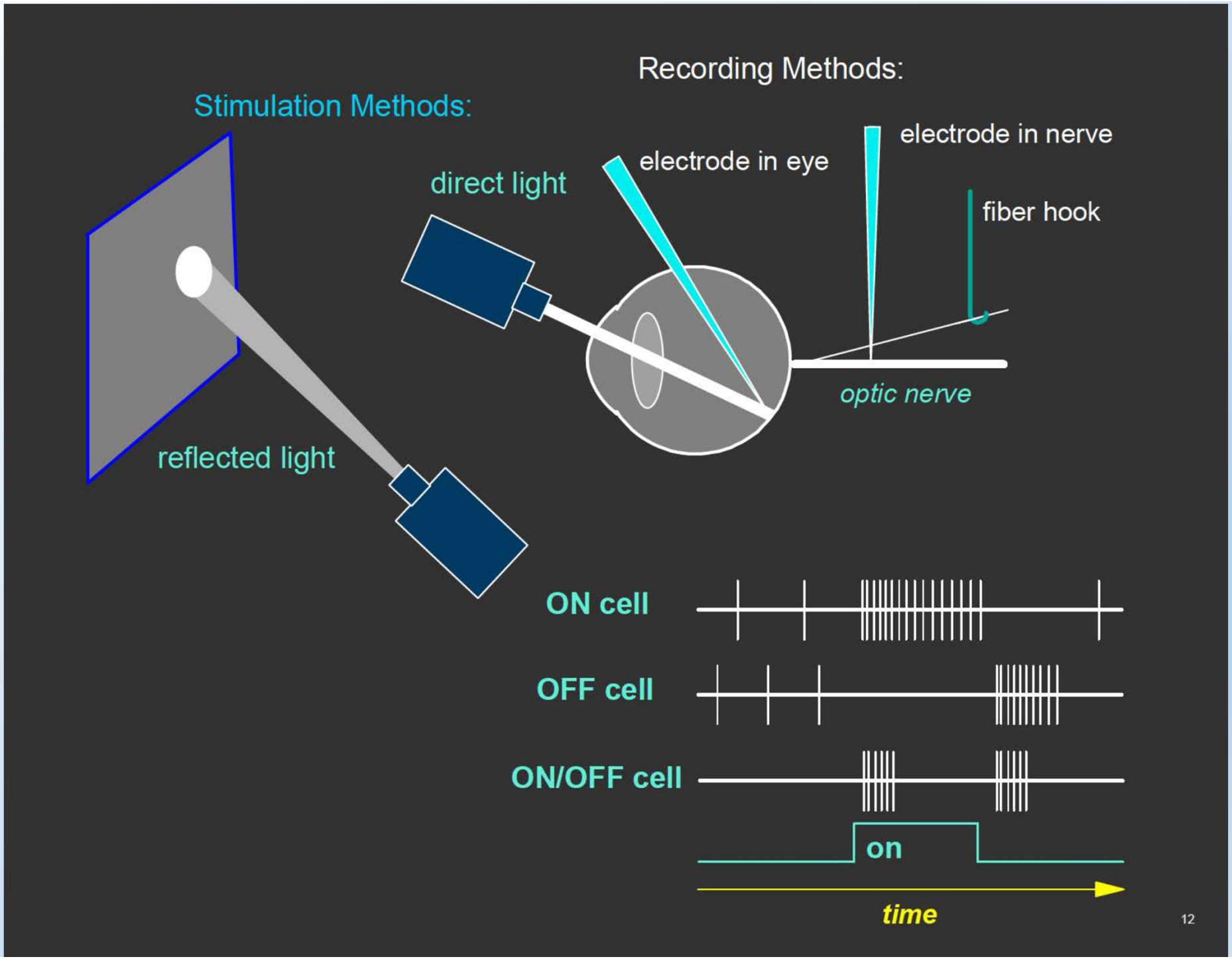
- 颜色
- 明暗
- 位置


Receptive field
Neuron's activity
Biggest response

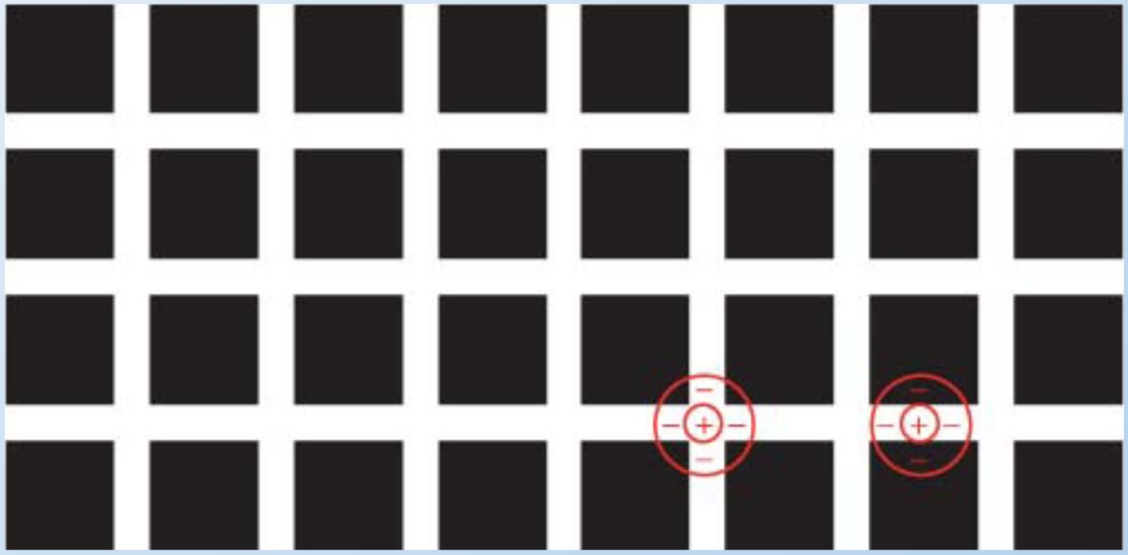

ON
Inhibition


OFF
Inhibition

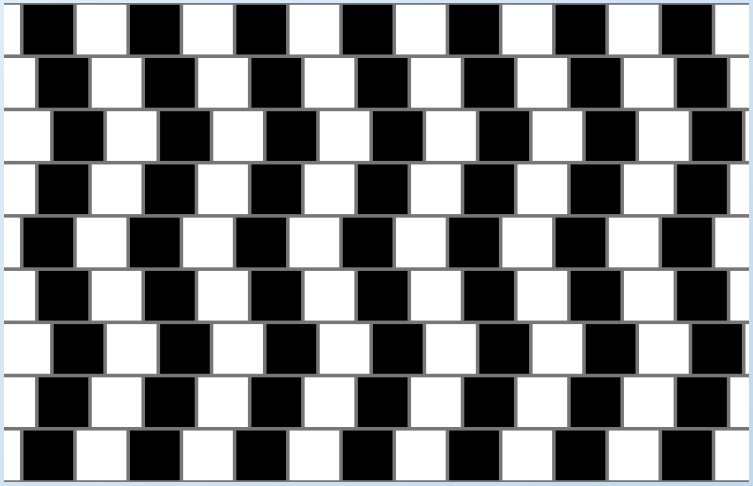

ON/
OFF
Inhibition

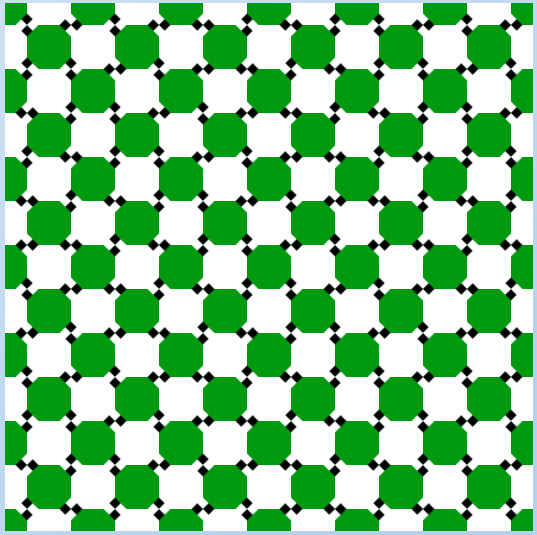

Recording Methods:
Stimulation Methods:
electrode in nerve
electrode in eye
direct light
fiber hook
optic nerve
reflected light
ON cell
OFF cell
ON/OFF cell
on
time

Hermann grid

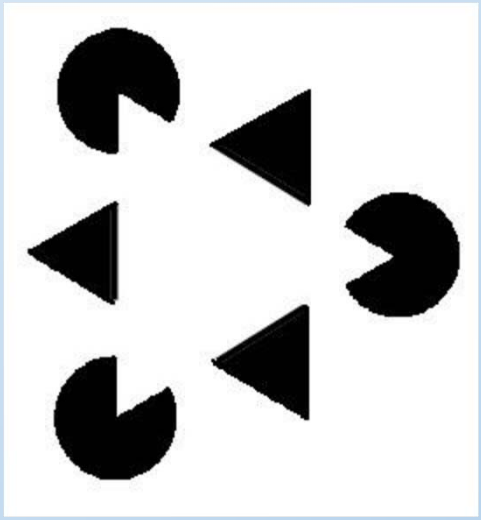


这个效应的位置在视网膜





这个在大脑



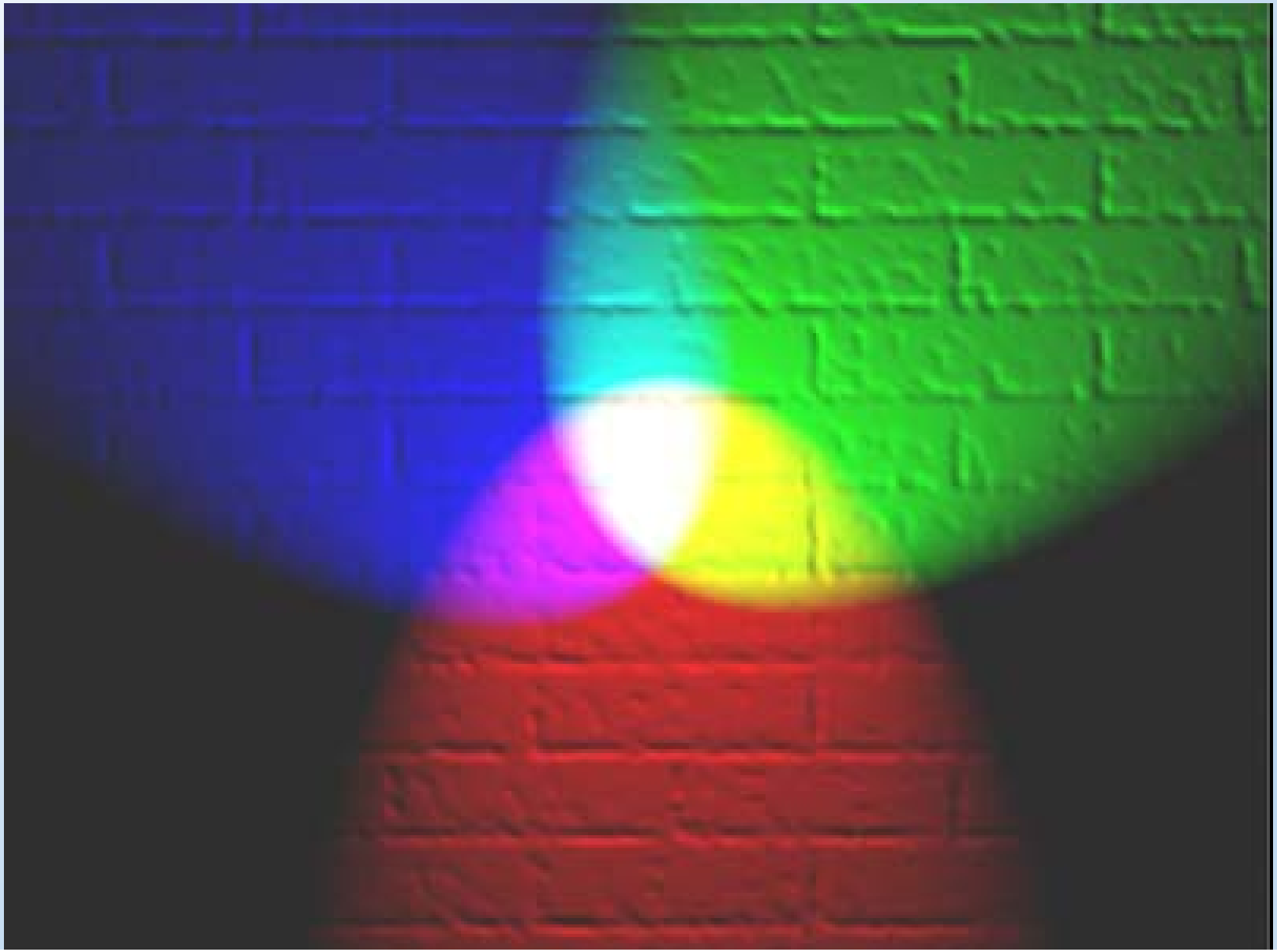
Processors

- 90 milliom Rod
- 4.5~6 million Corn
- 1.5 million RGC
- one LGN = 1 million neurons
- V1 (striate)= 250 million neurons
- extrastriate = 400 million neurons
- 1.3 billion visual cortical neurons
- 600 cortical/1 LGN neuron

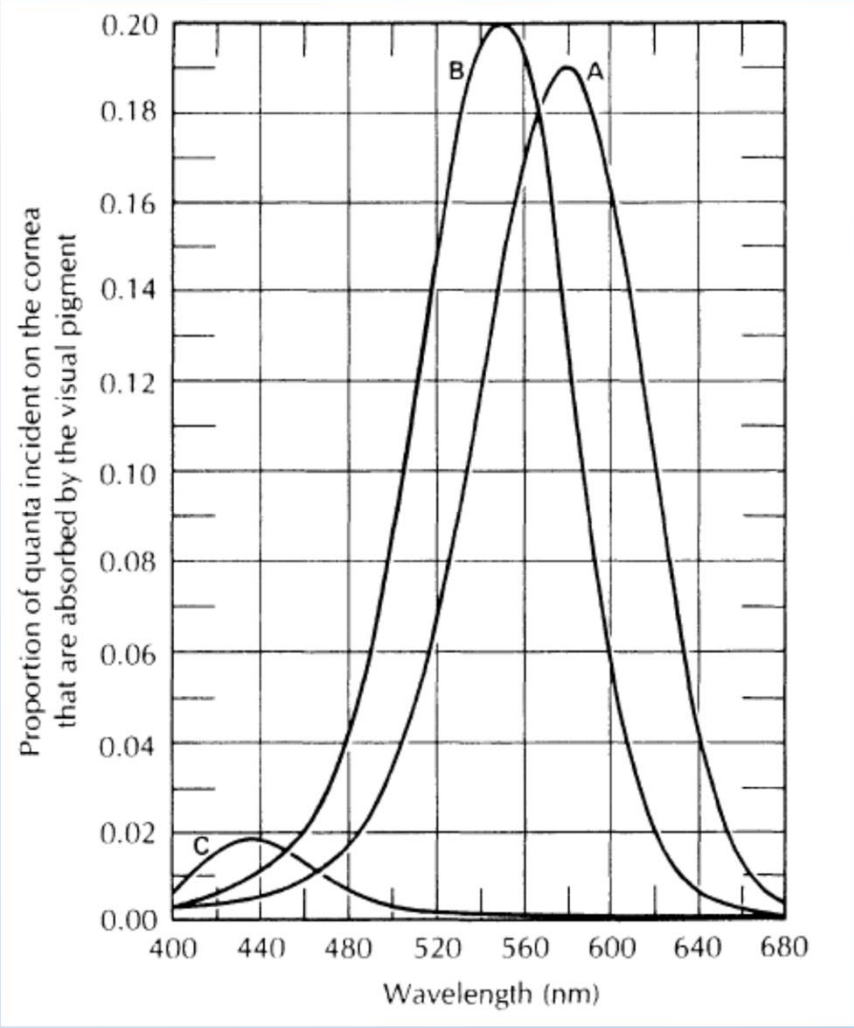
- 1 degree = 200u on retina
- Intercone distance in fovea = 2.4u (0.7 min)
- 200,000 cones per sq.mm. in fovea
- 20,000 cones per sq.mm. 5 degrees out

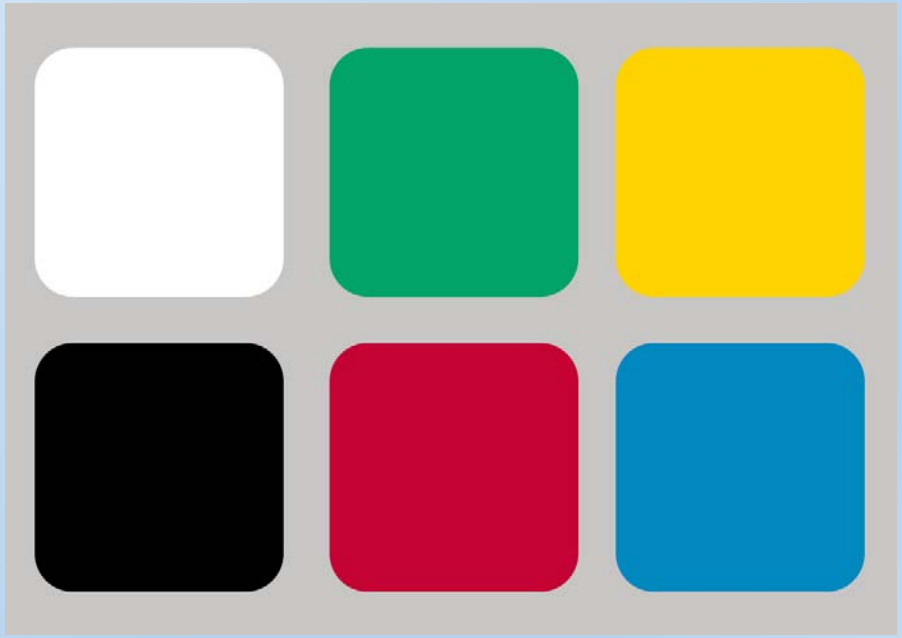
颜色视觉

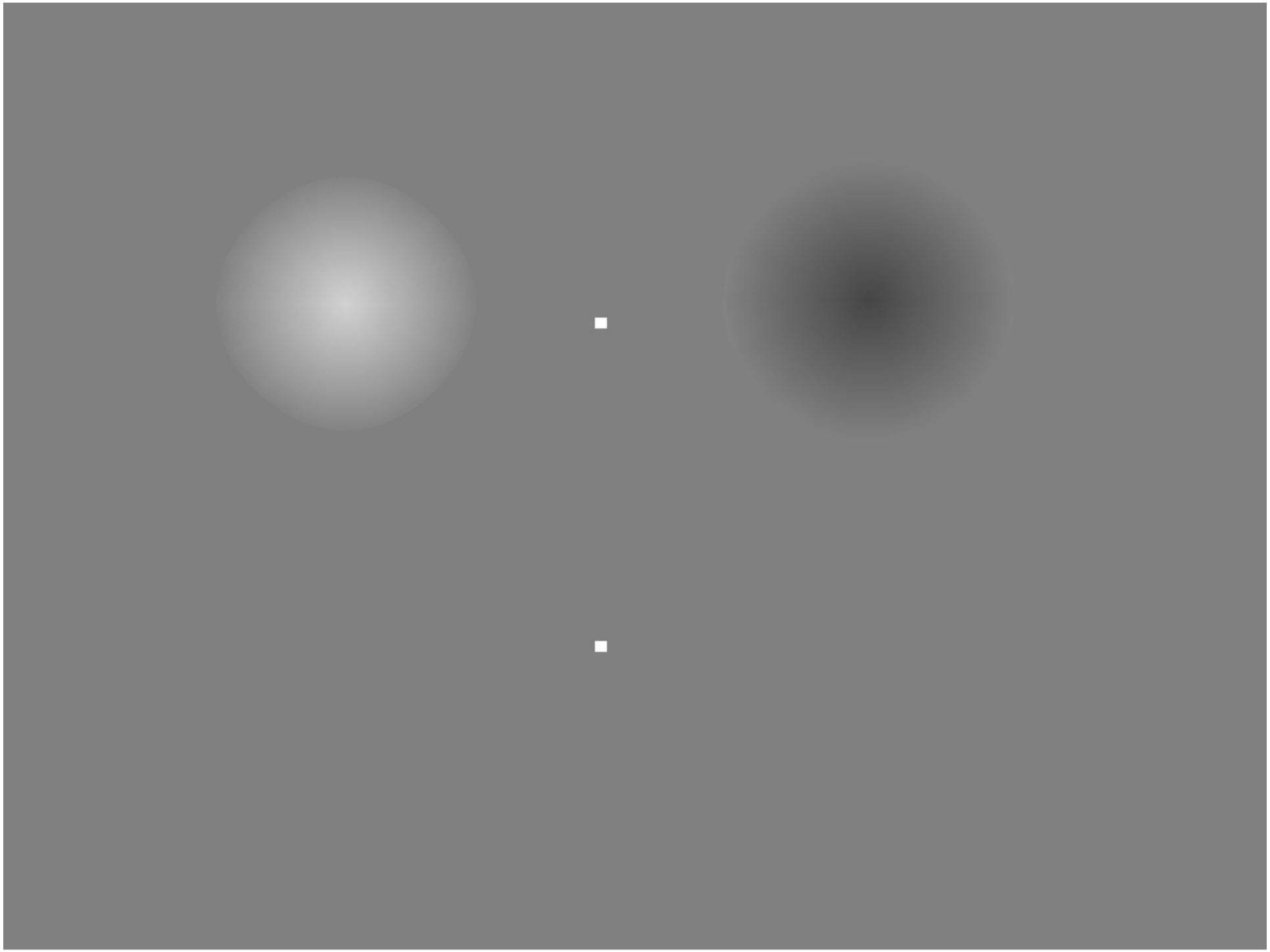
RGB theory

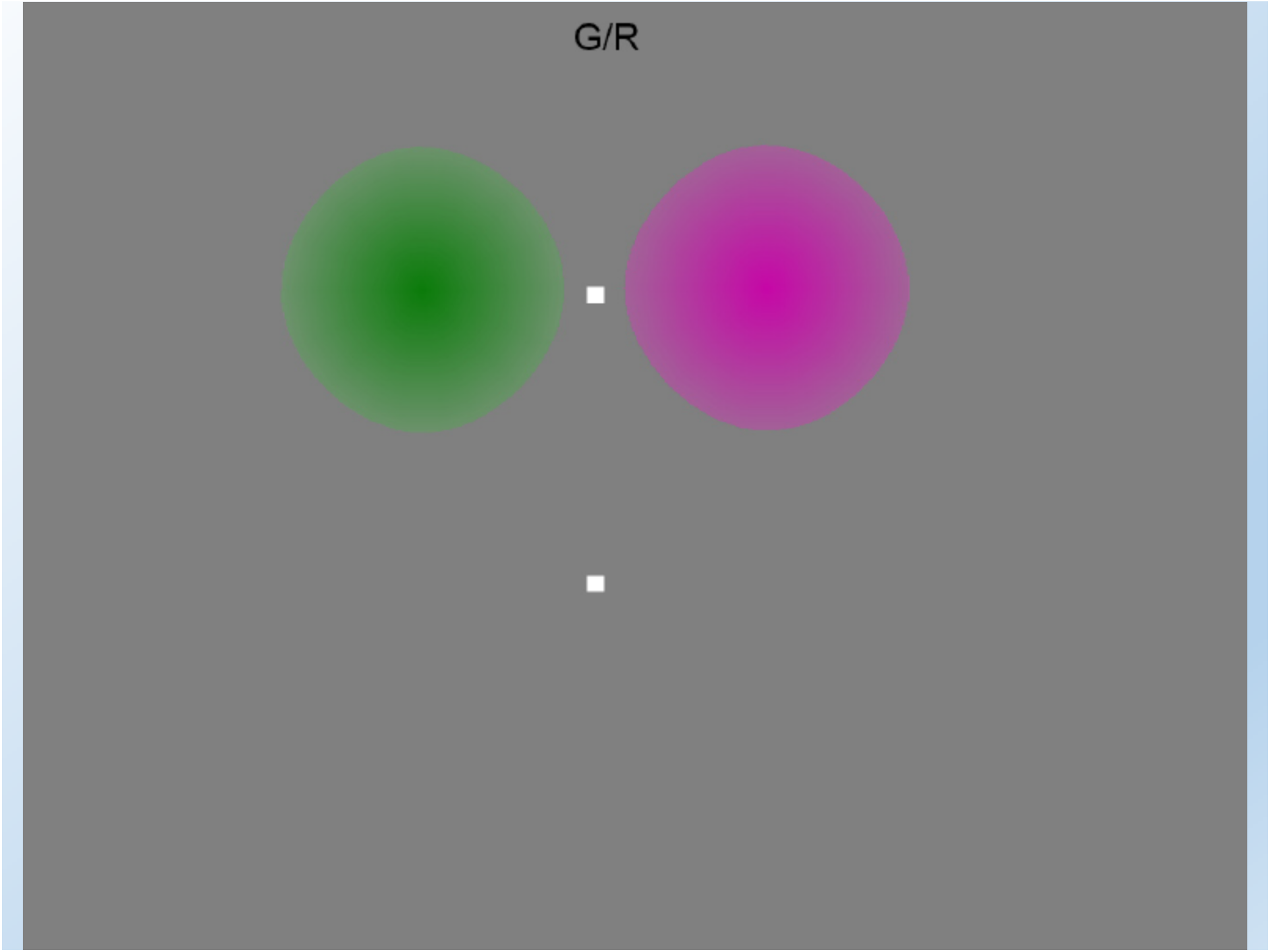


我们实际上看到的是什么

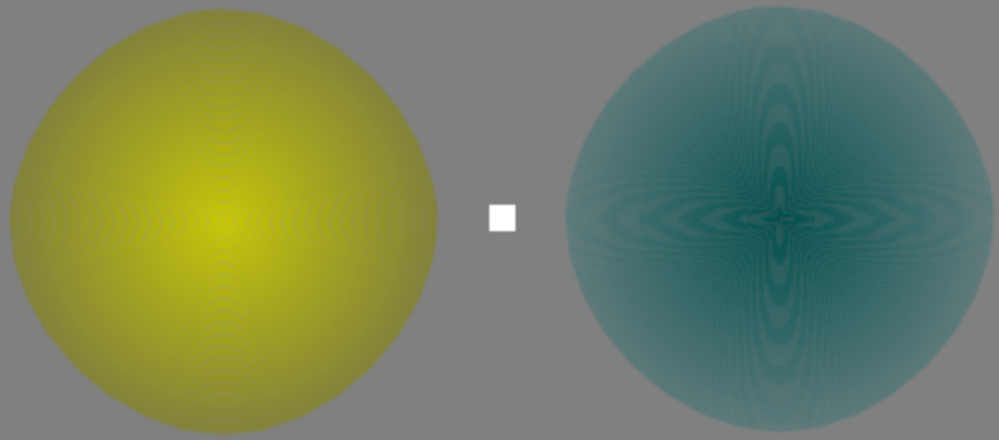







G/R

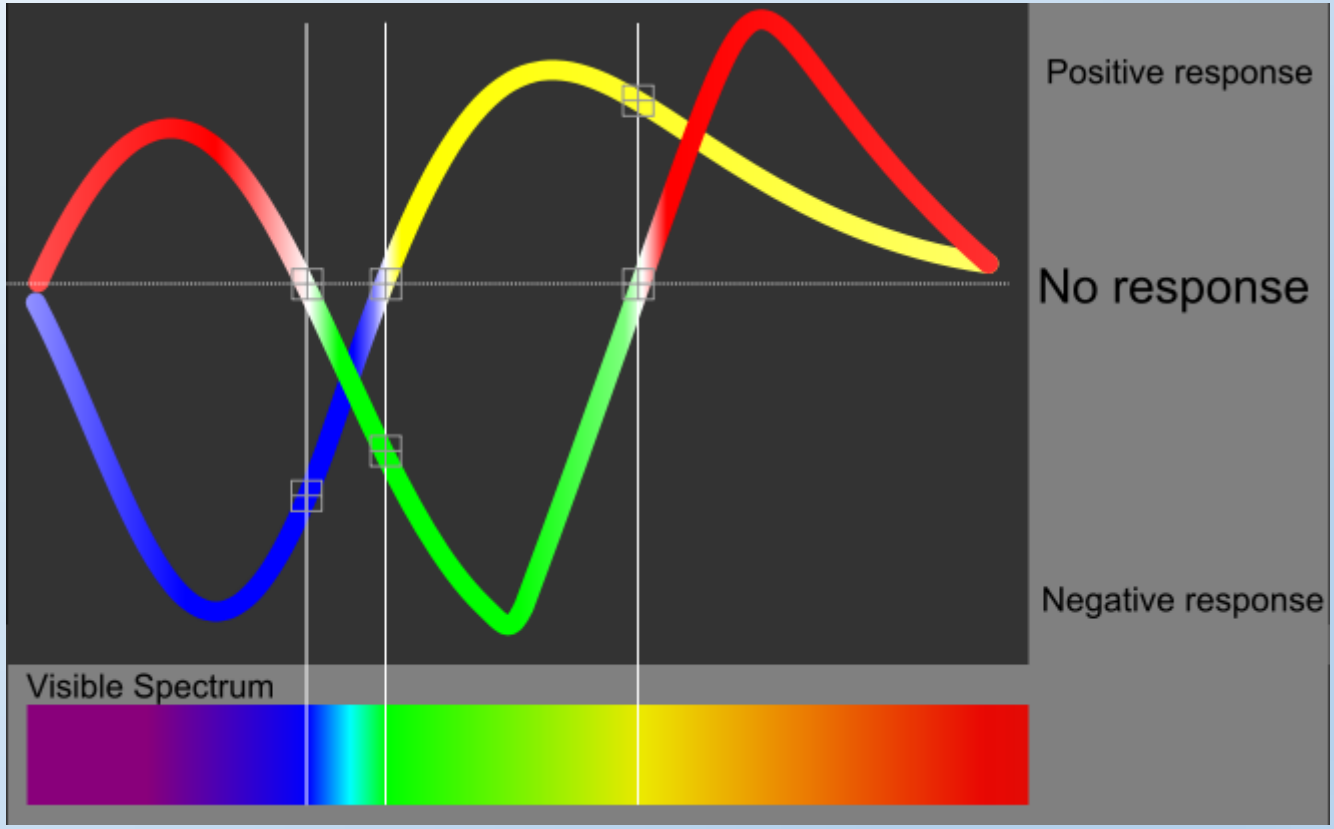
off axis

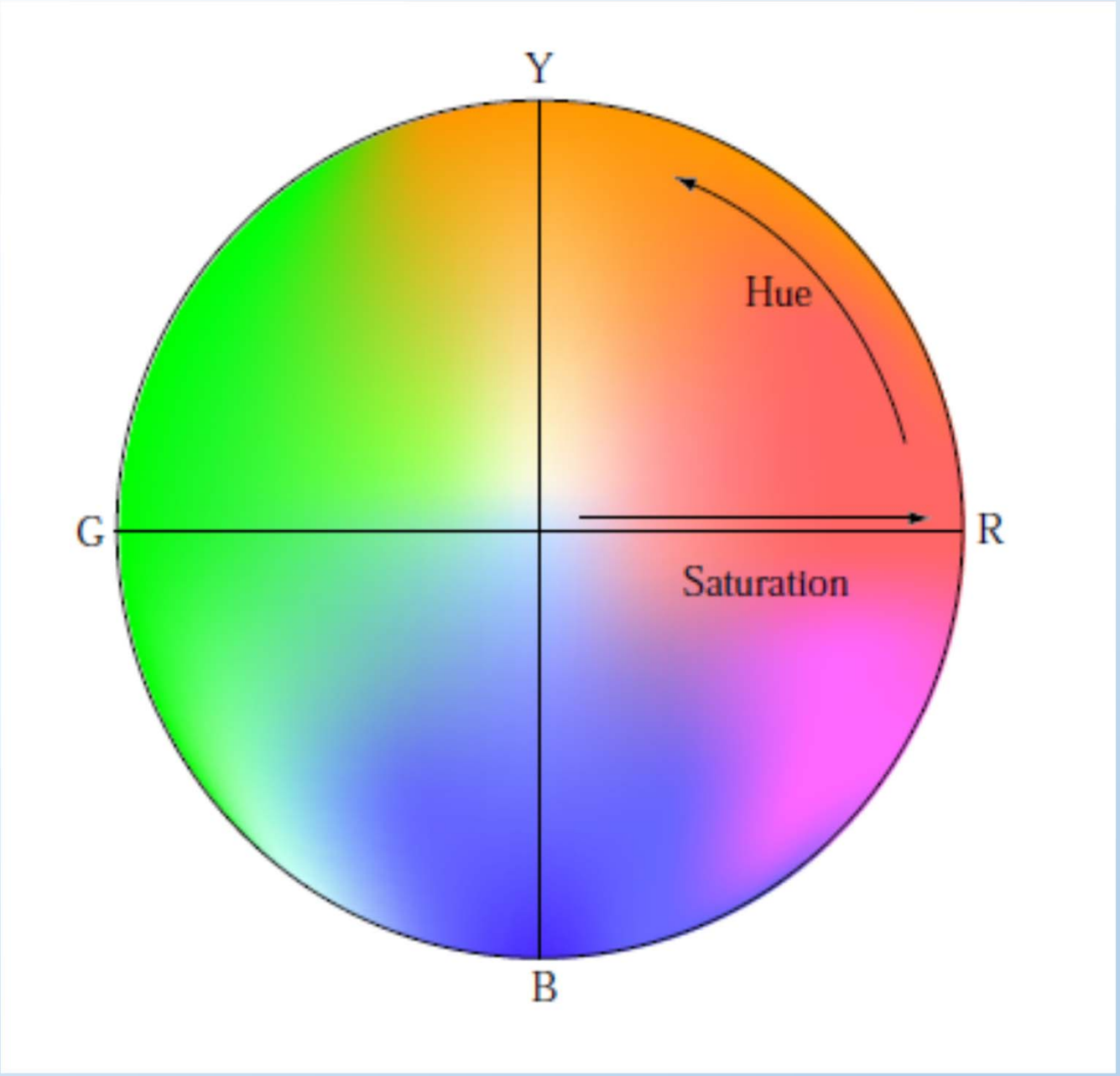



keep staring at the black dot.


johnsadowski.com

视觉颜色系统

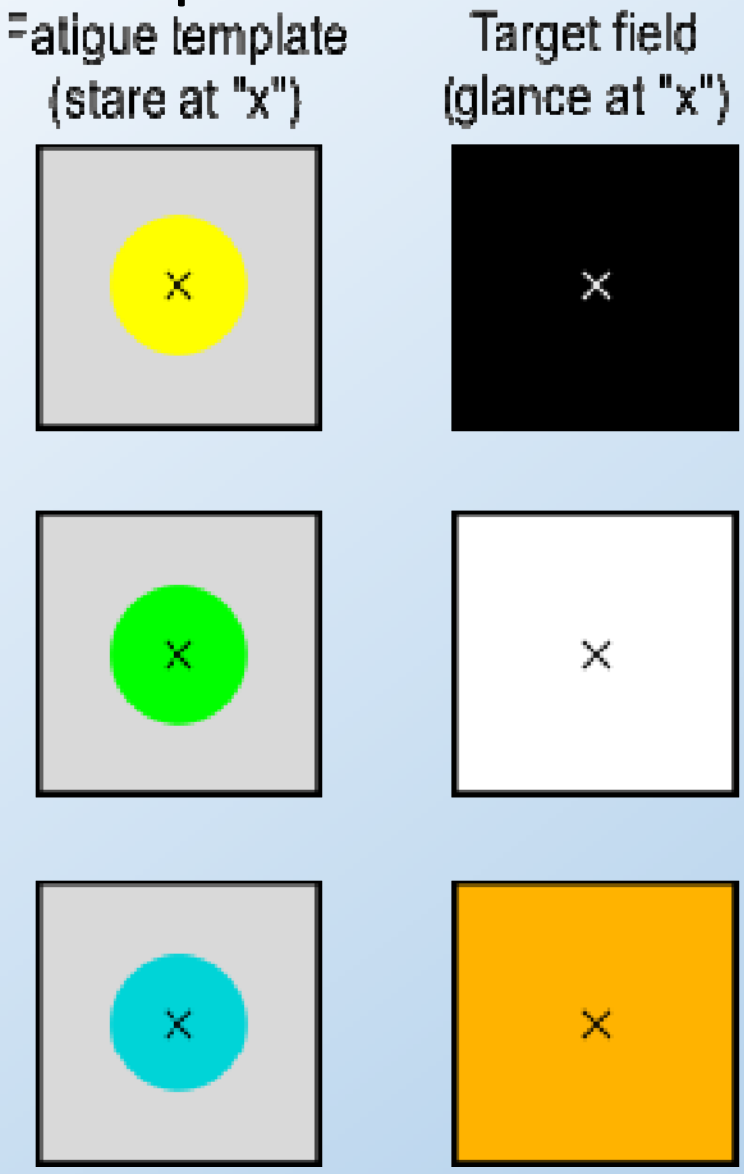

Positive response
No response
Negative response
Visible Spectrum



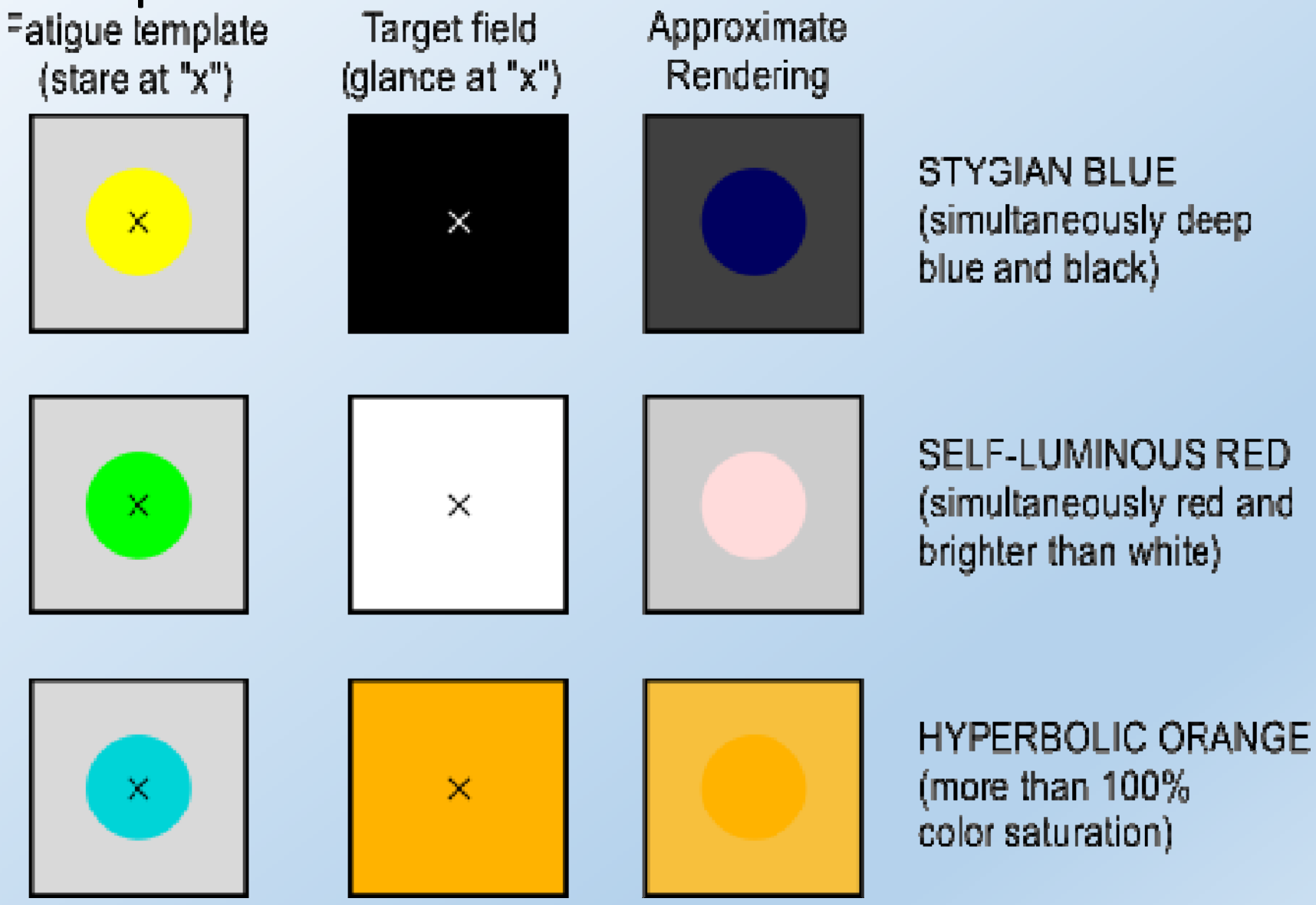
Color cycle

Red ON
Red OFF
Green ON
Green OFF
Blue ON
Yellow ON

Impossible colors

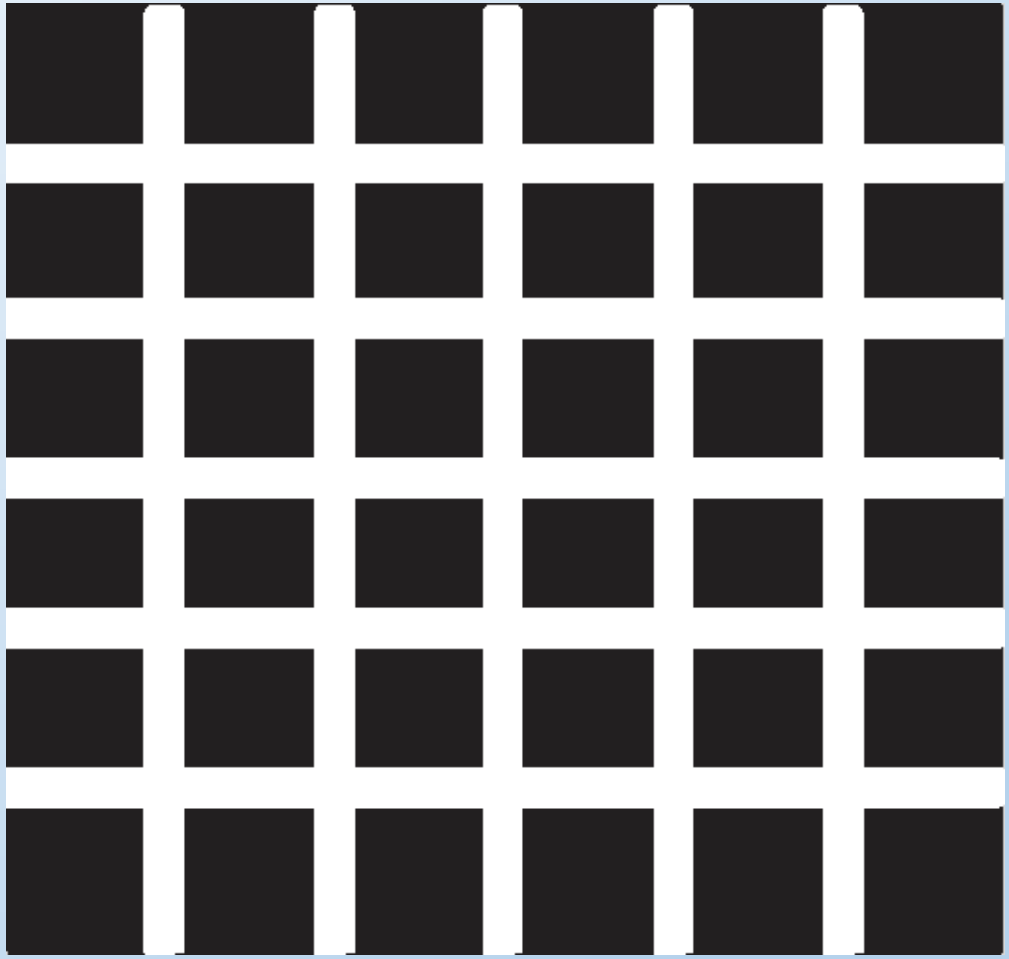


Impossible colors

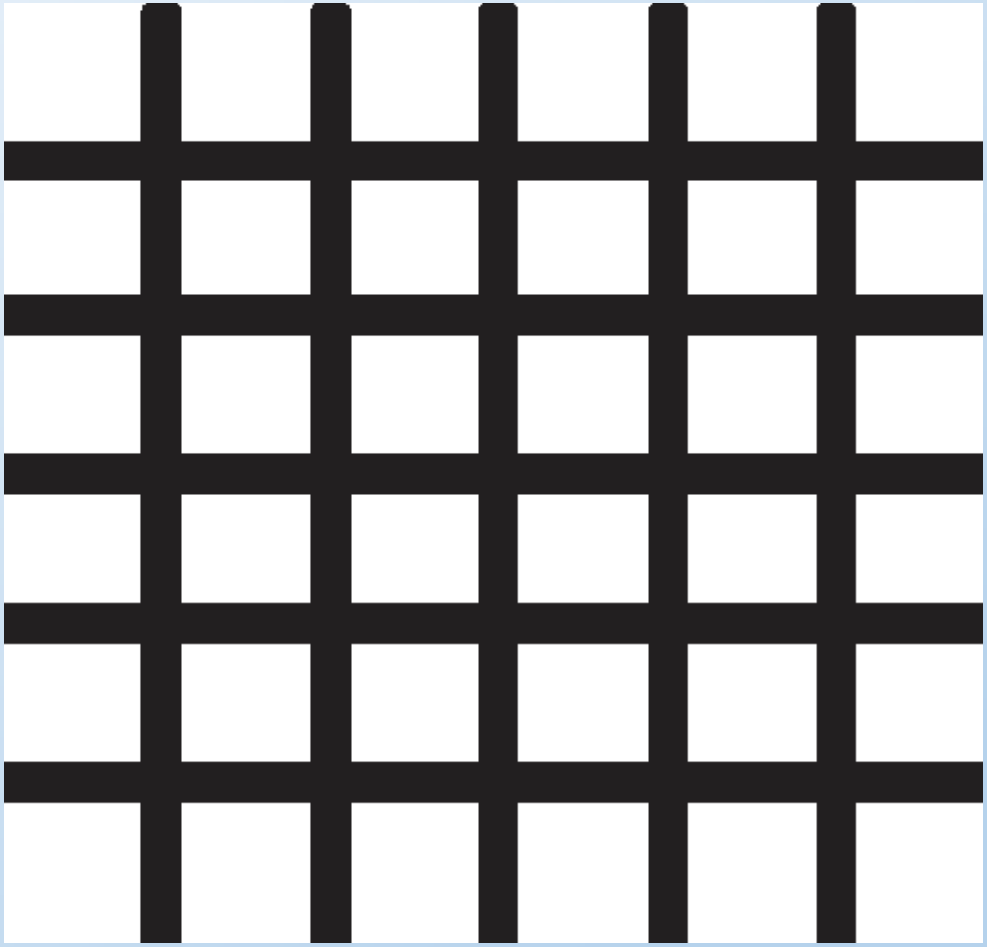


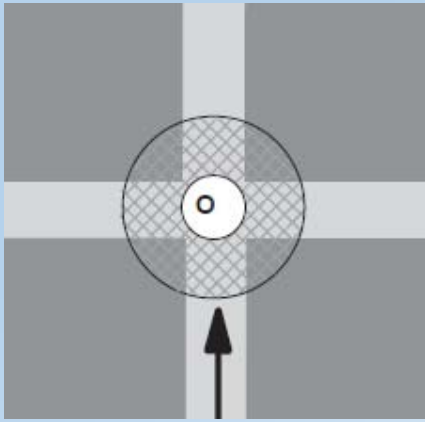

Starry Night by Vincent van Gogh (1889)

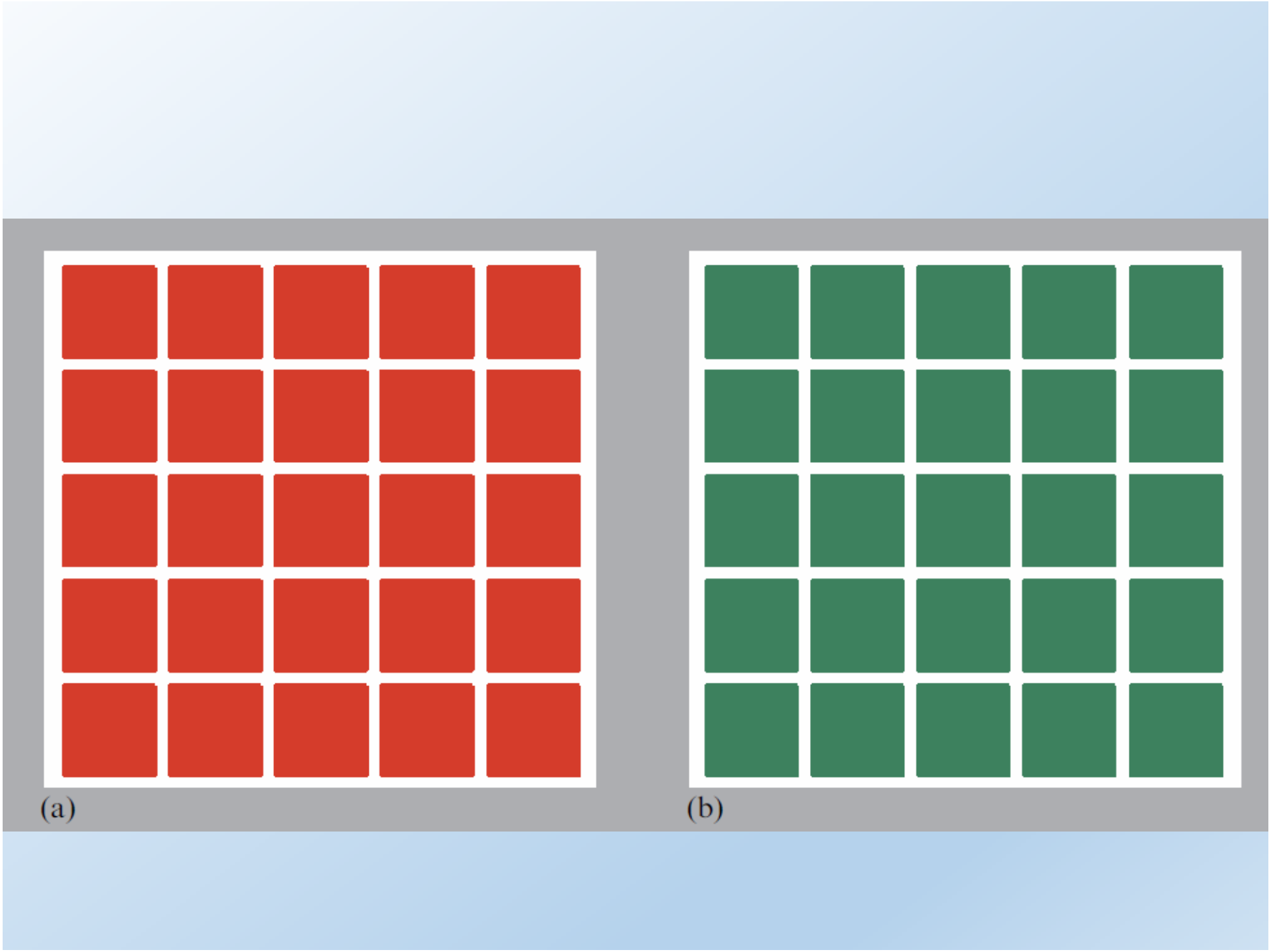
Hermann grid illusion



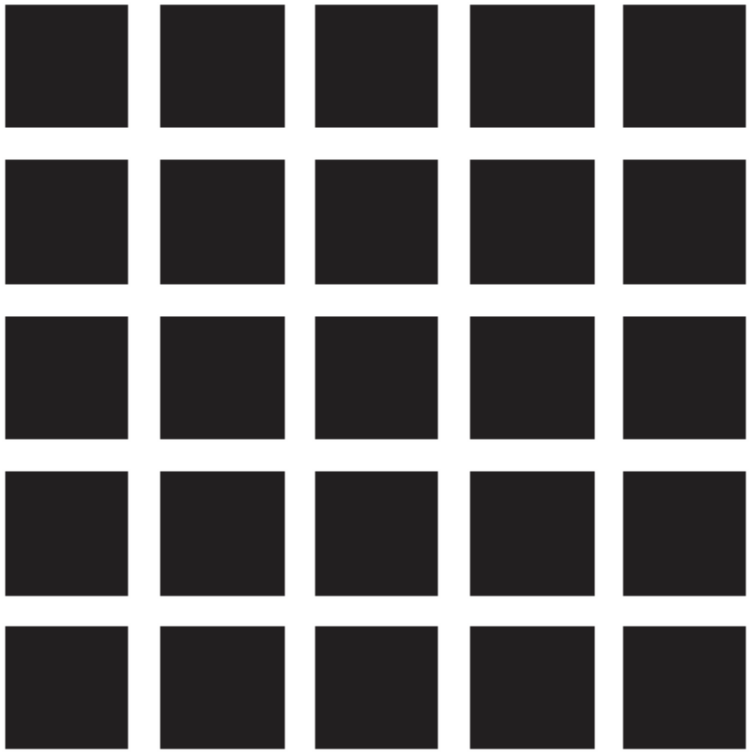
The Hermann grid illusion revisited, Perception, 2005, volume 34, pages 1375 ~1397

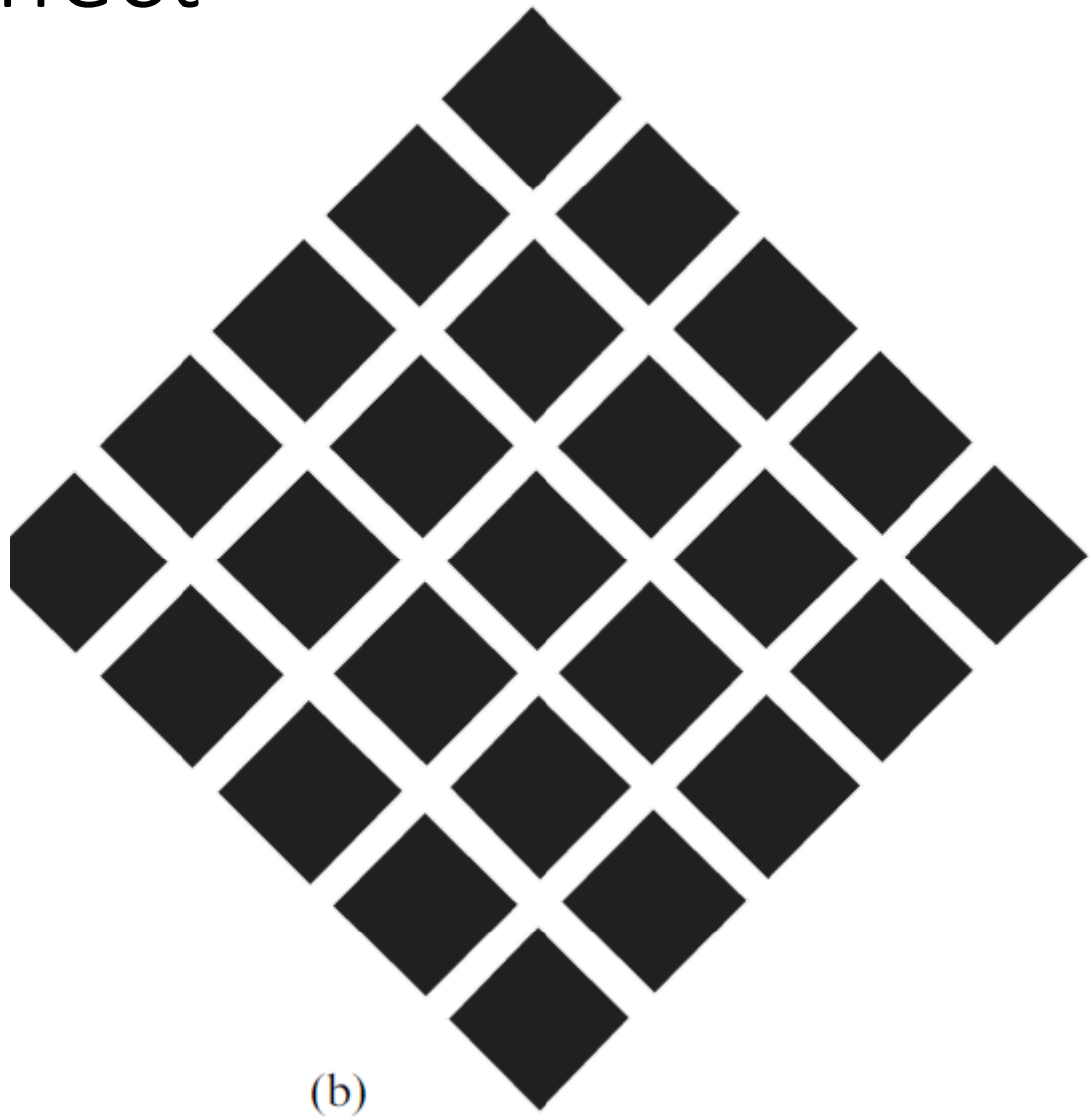




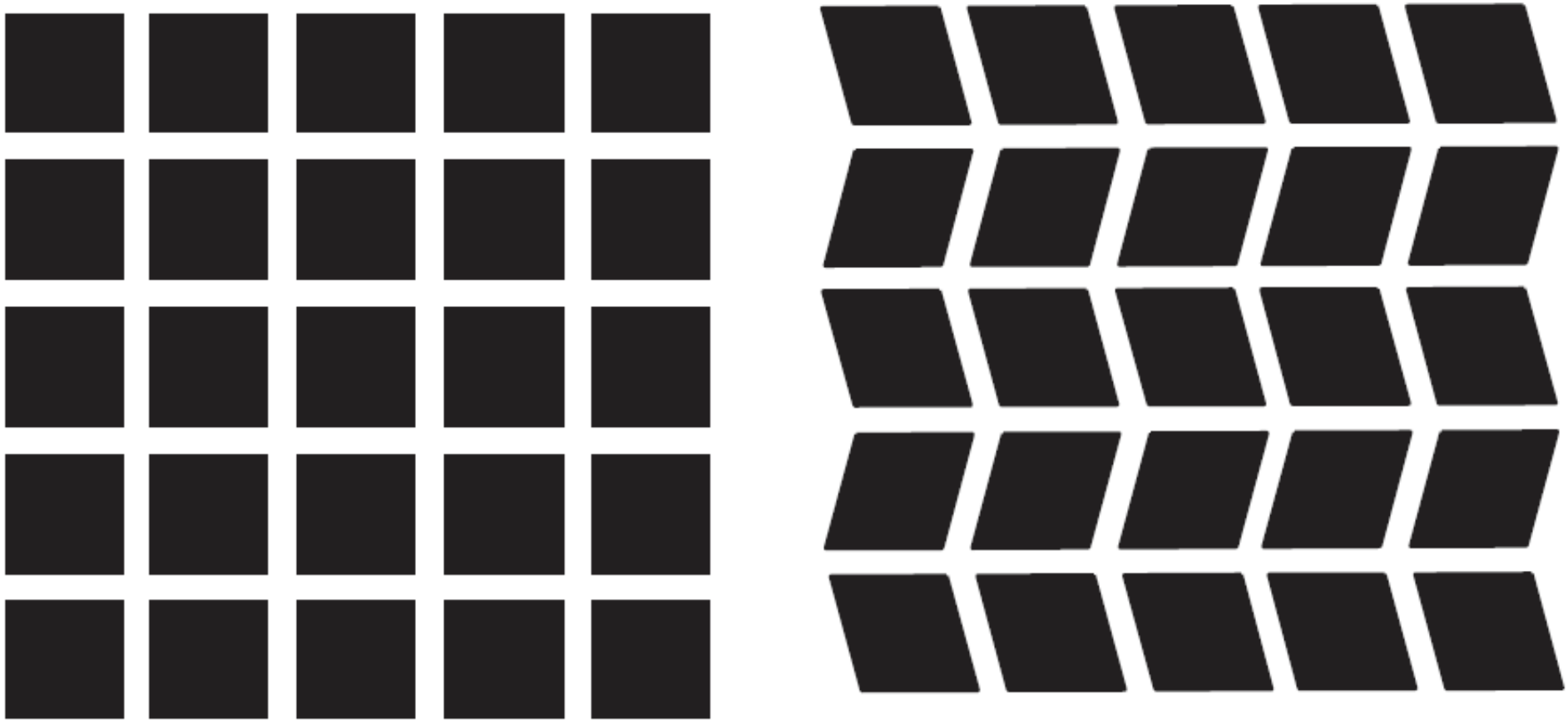

(a)
(b)

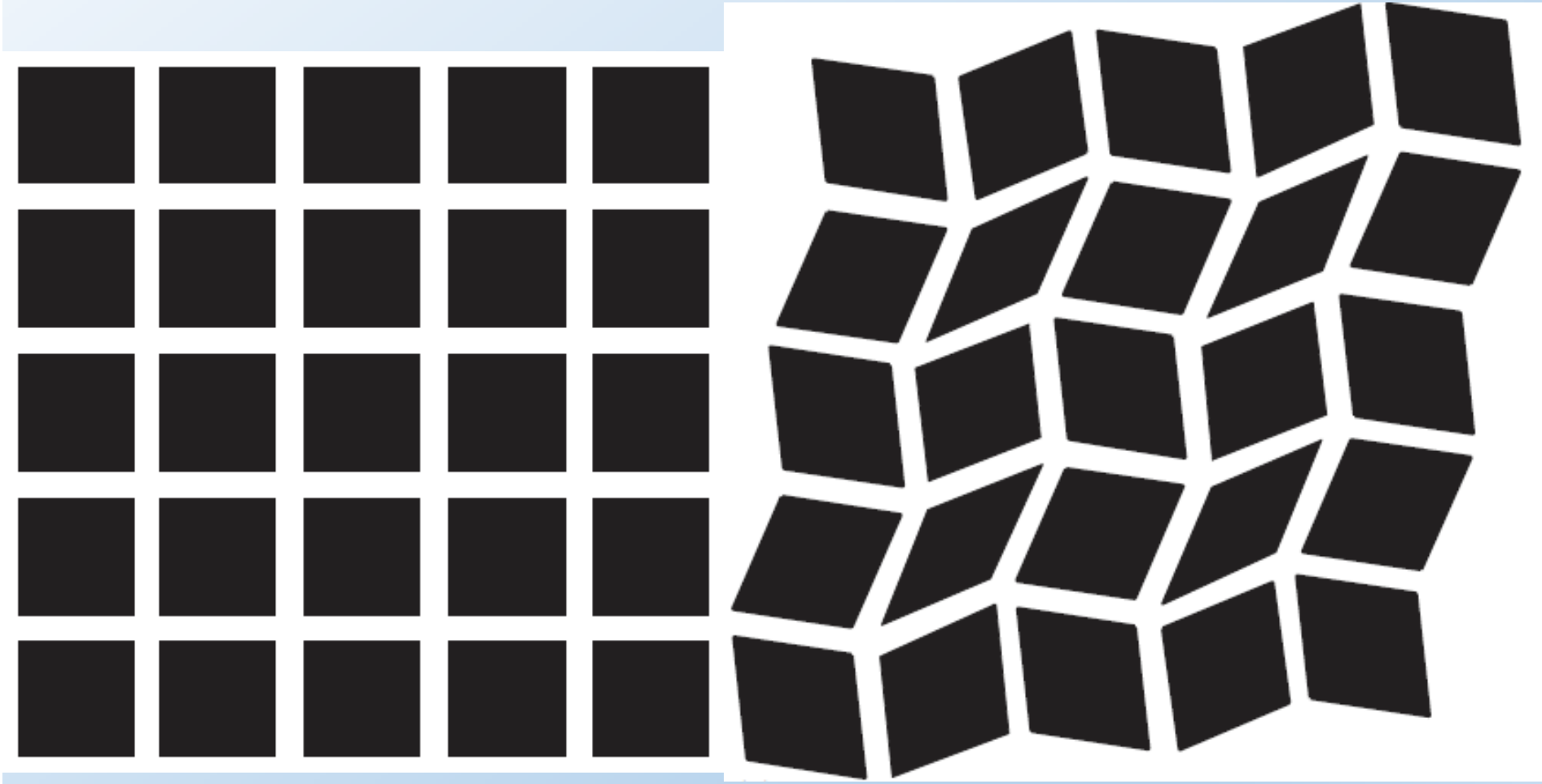
to change this effect

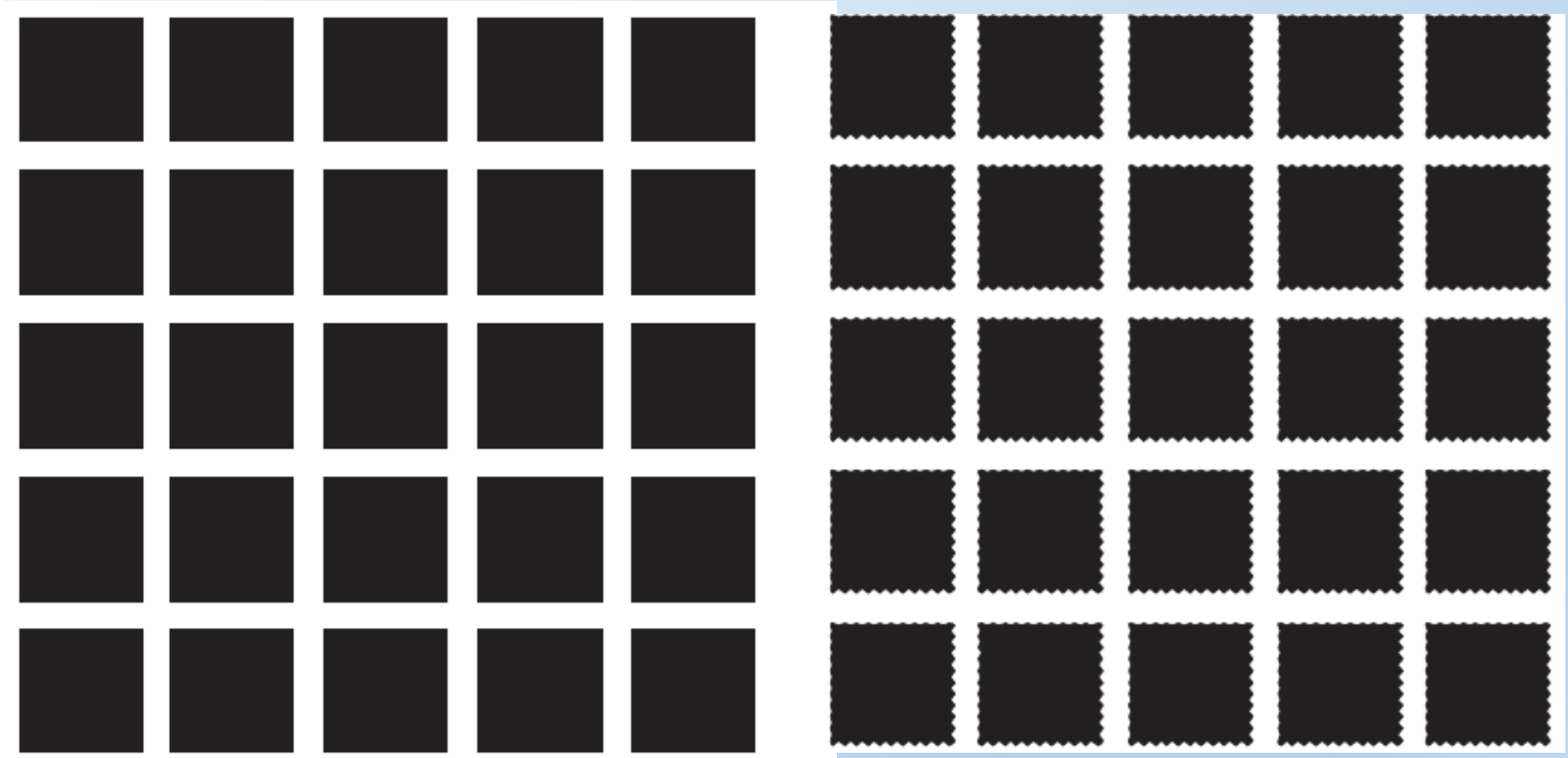


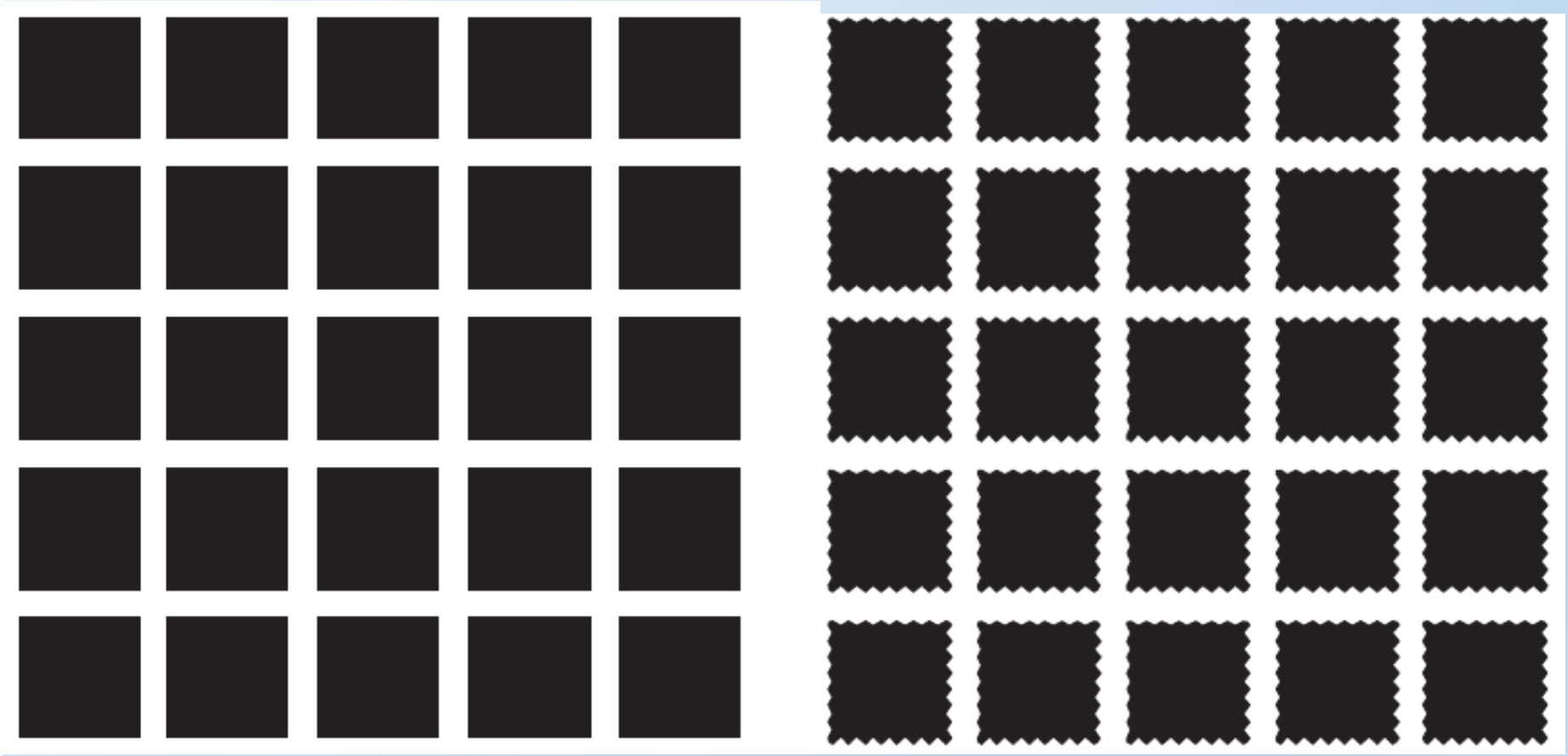


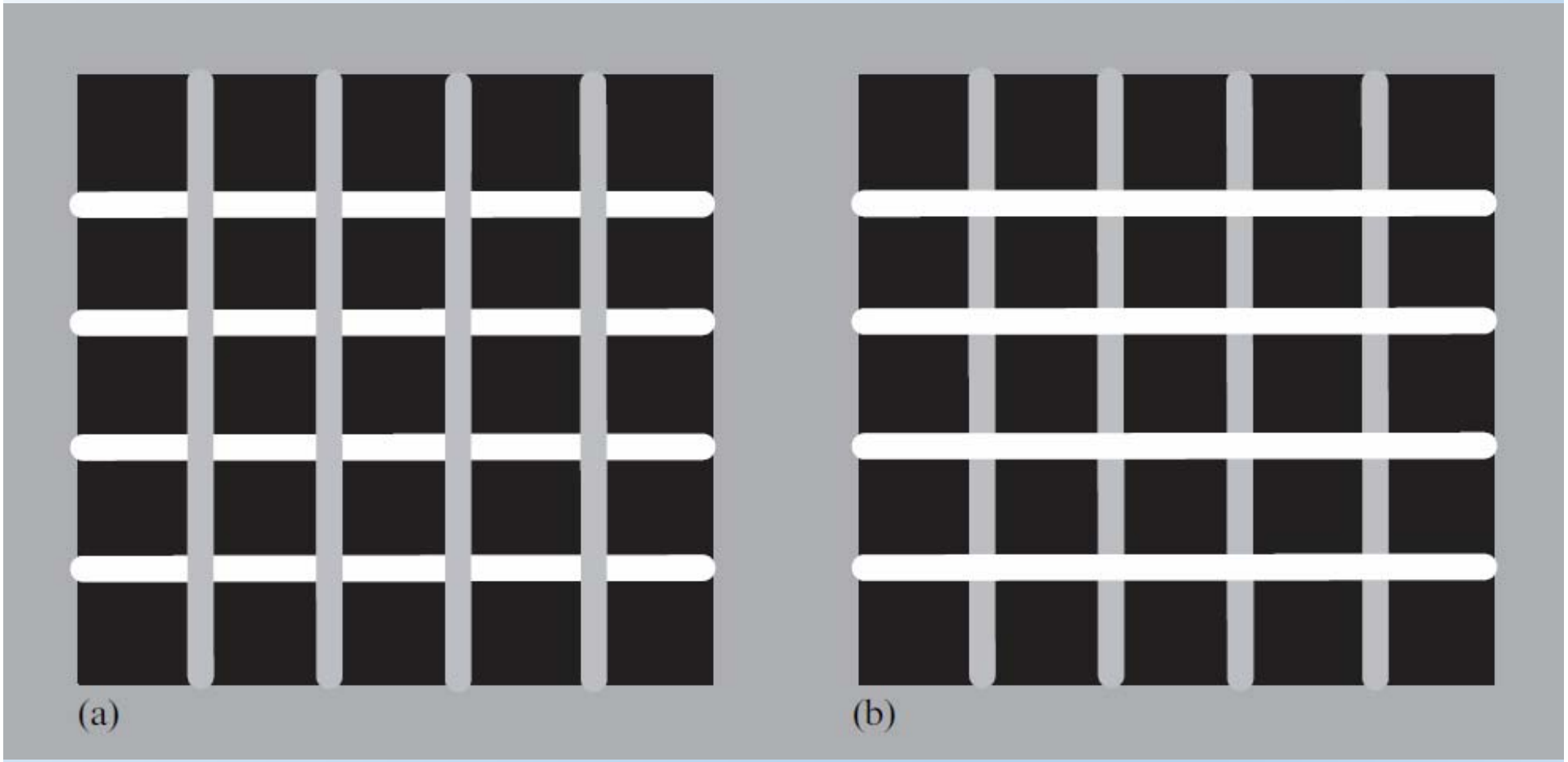
(b)

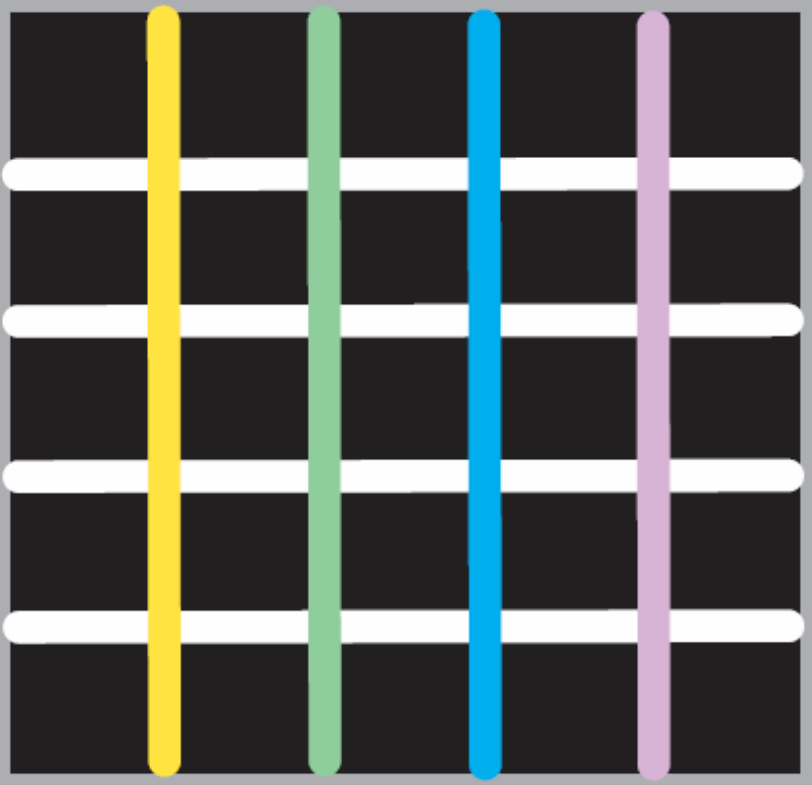




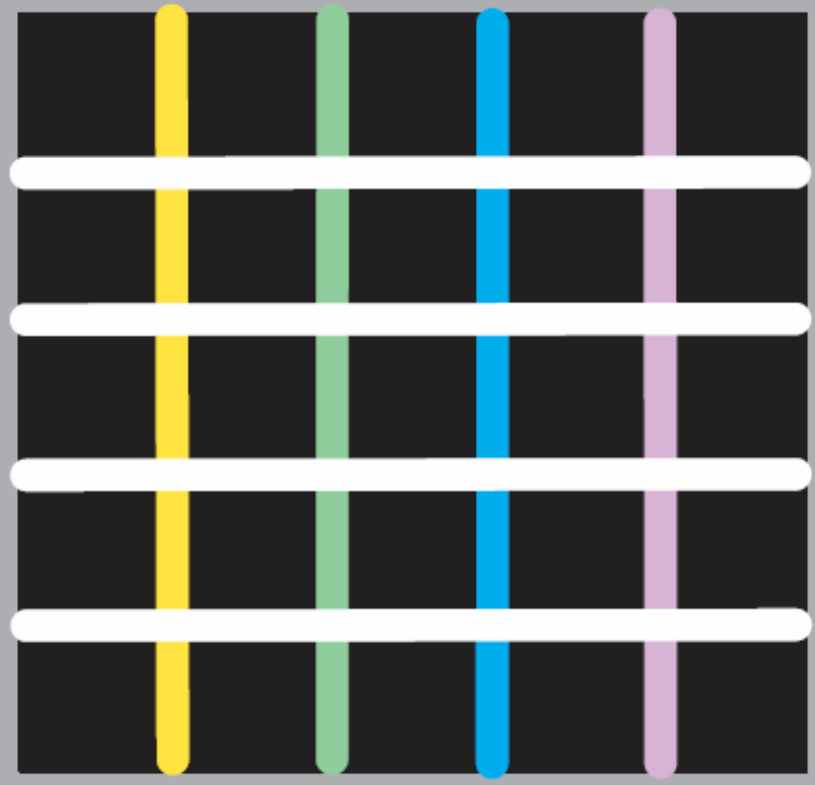




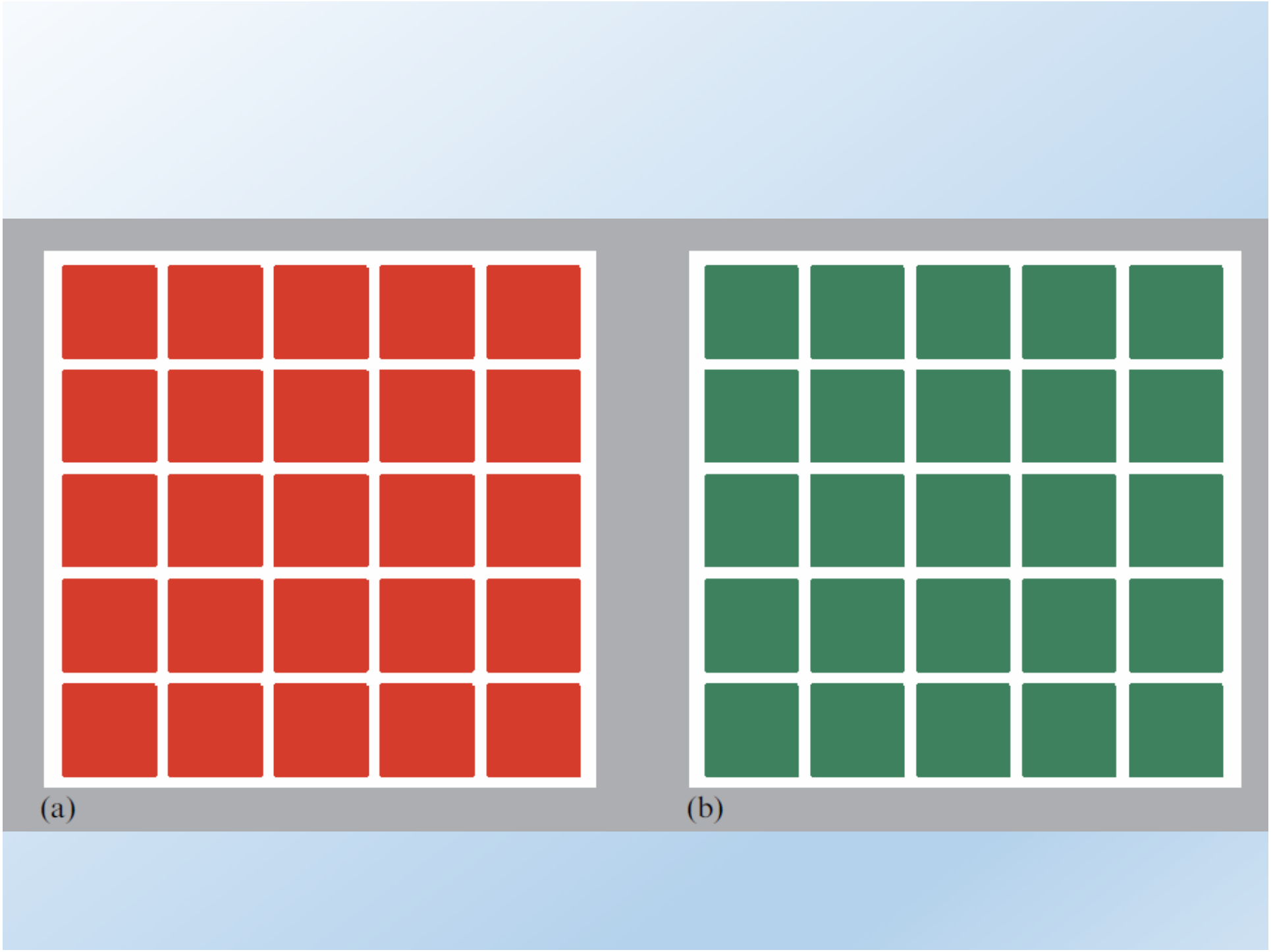

(a)
(b)

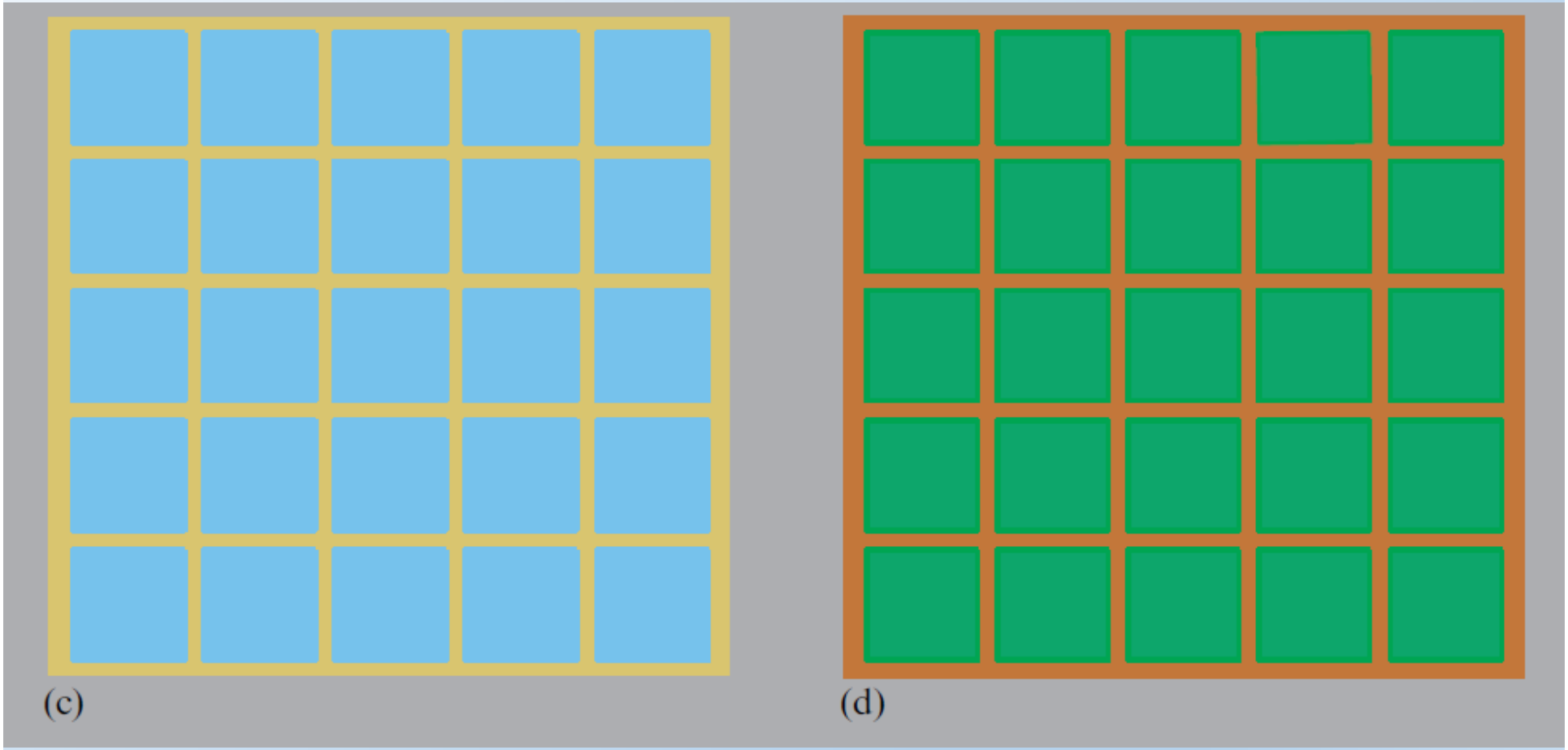


(c)

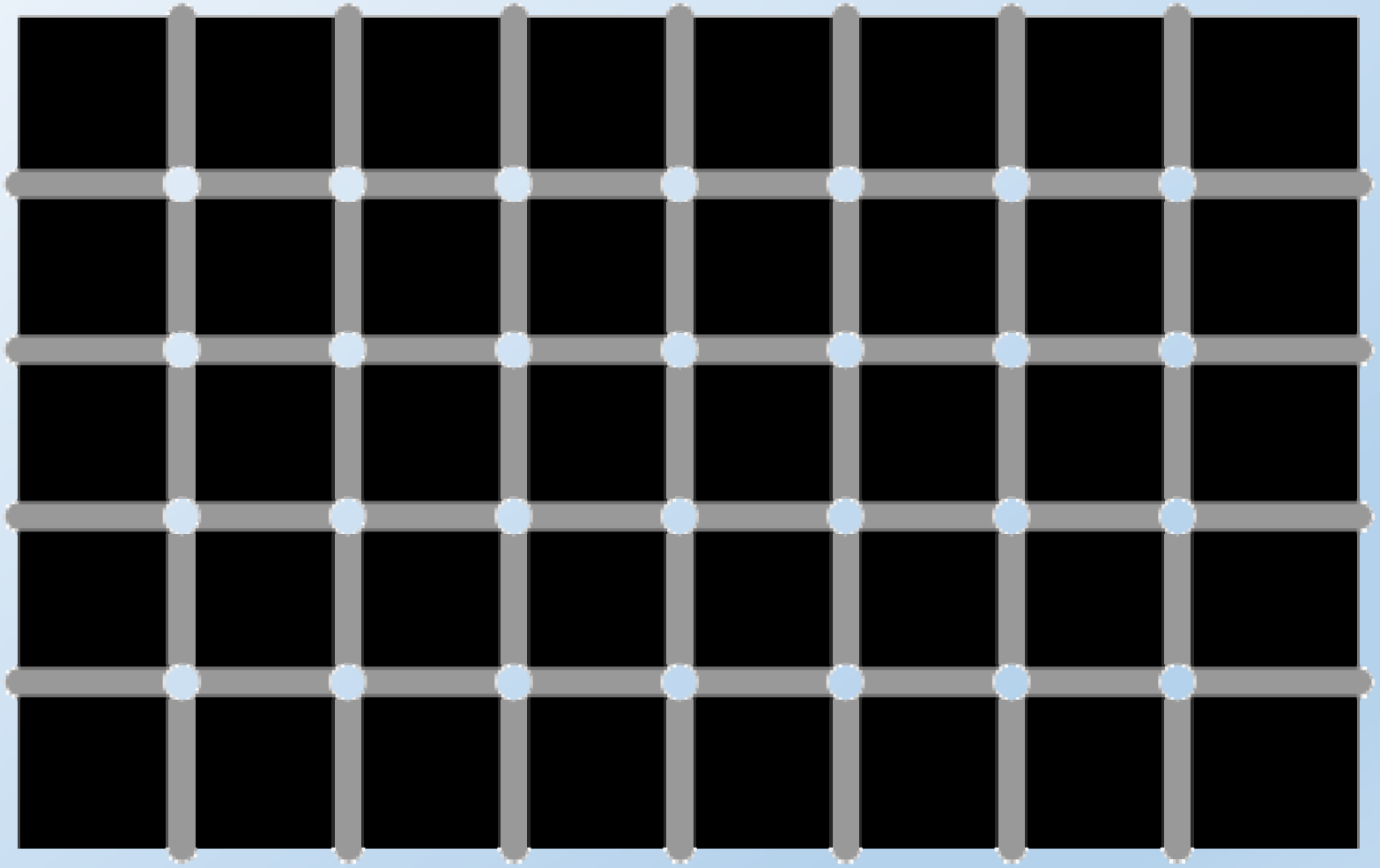


(d)

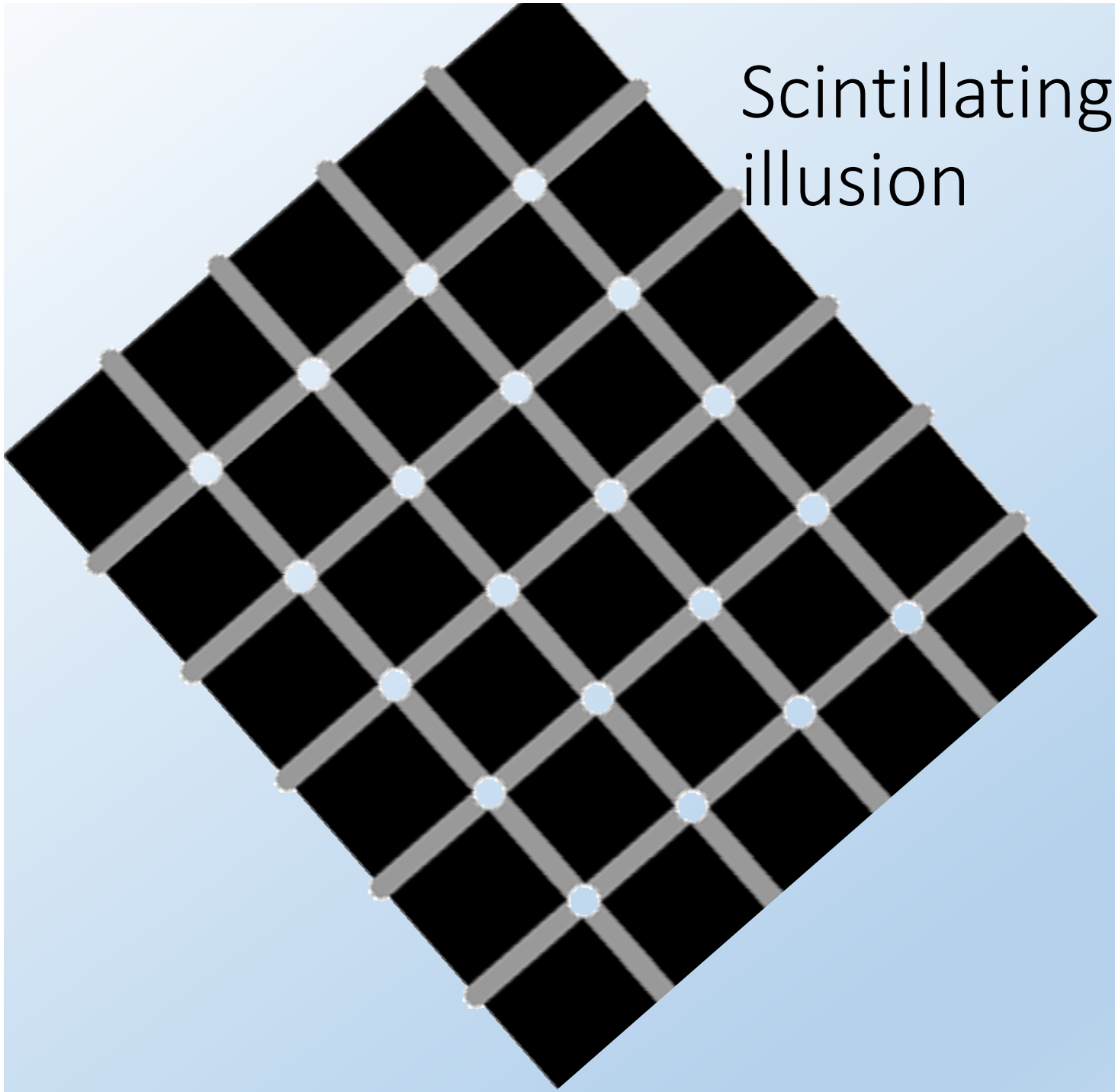

(a)
(b)


(c)
(d)

Scintillating grid illusion



Scintillating grid illusion



作业：

- 就 Hermann grid illusion， 写一份研究论文
  - 现象的描述
  - 目前解释这一现象的理论
  - 这些理论的优缺点

  - 你的看法。