

Lecture 2-1 The human visual system, perception (chapter 2.1)

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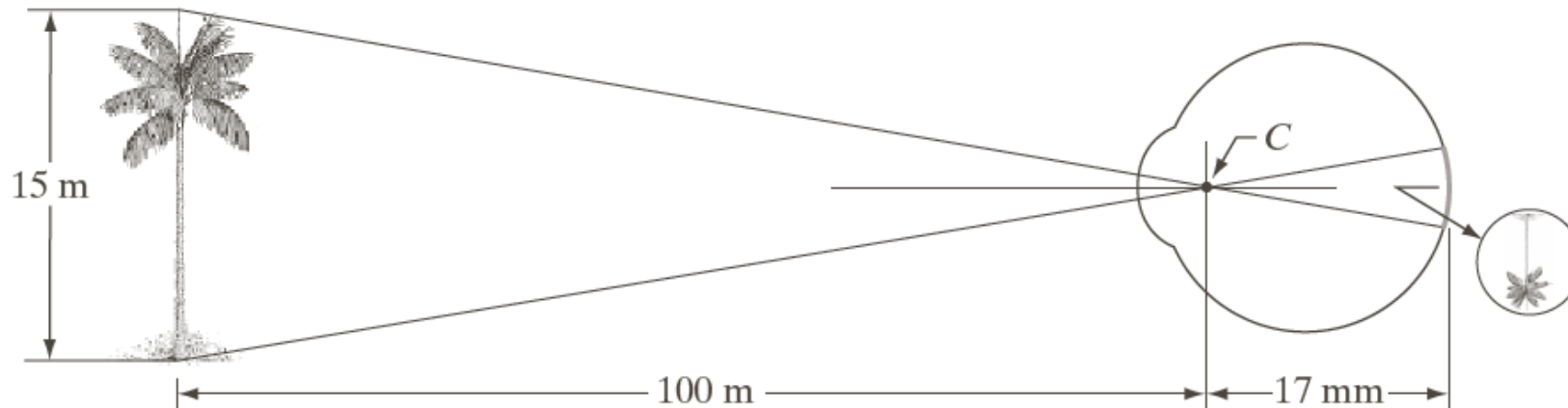
Outline

- Anatomical structure of eye ball.
- Image formation and brightness adaptation in the eye.
- Visual illusions.



Graphical representation of human eye

- Objects captured as focused images on the image plane at retinas
- Perspective projection based on pinhole model geometry,
- Image size depends on distance of object
- In practice, optical devices with lens



Human Visual Perception

Lens: 晶状体
Blind spot: 盲点

Rod: 杆状体
Cone: 锥状体

Fovea: 中央凹
Retina: 视网膜

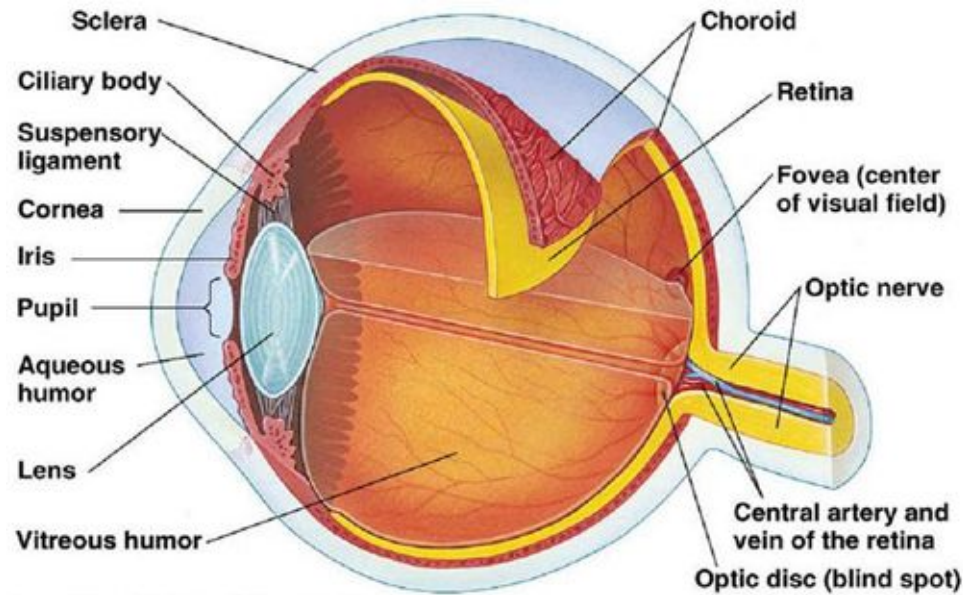


Figure 2.1: Sagittal Eye ball anatomy .

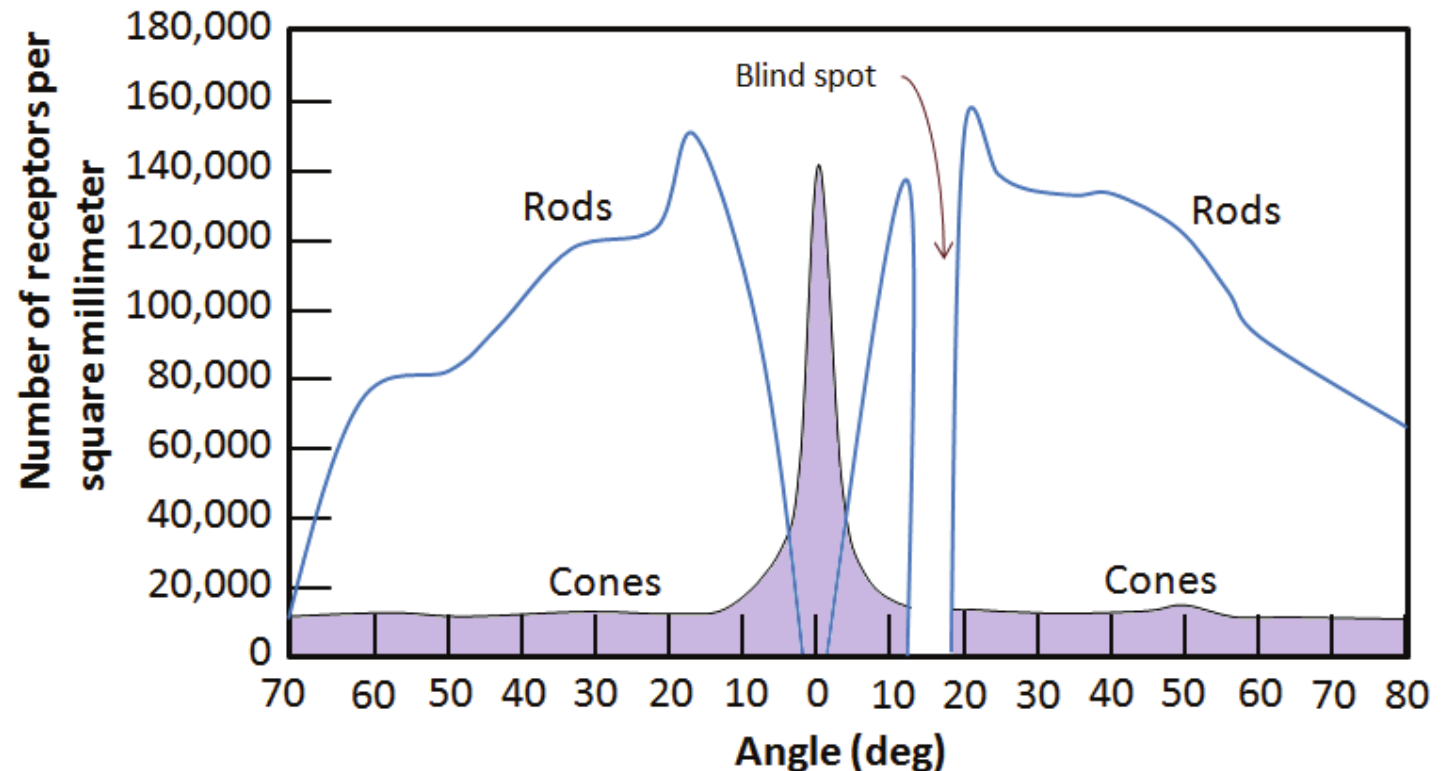
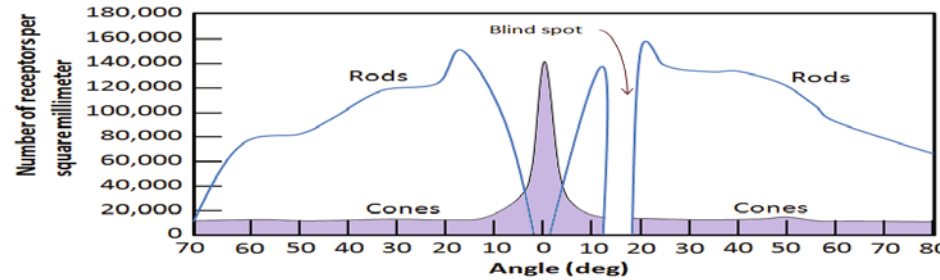


Figure 2.2: Distribution of rods and cones in the retina.

Human visual system perception elements



• Rods

- Sensitive to light intensity.
- Night “scotopic” vision.
- Achromatic.
- Low acuity (many per nerve end).
- Peripheral vision.
- Slow response.
- 75-150 Million/Retina.

• Cones

- Only direct to direct light.
- “Photopic” vision.
- Chromatic (3 “colors”).
- Concentrated in fovea (1 per nerve end).
- High visual acuity, spatial resolution.
- Fast response.
- 6-7 Million/Retina.



Characteristics of Human Visual System

- **Brightness adaption**
- Simultaneous contrast
- Mach band effect
- Optical illusion

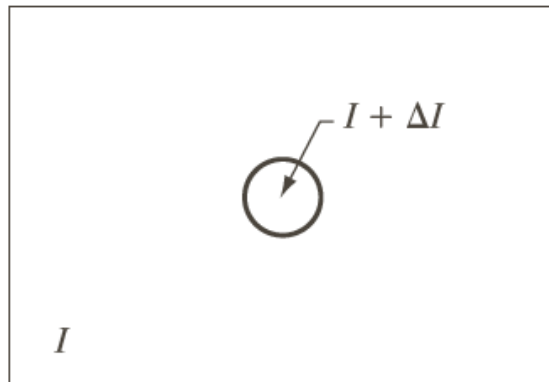


FIGURE 2.5 Basic experimental setup used to characterize brightness discrimination.

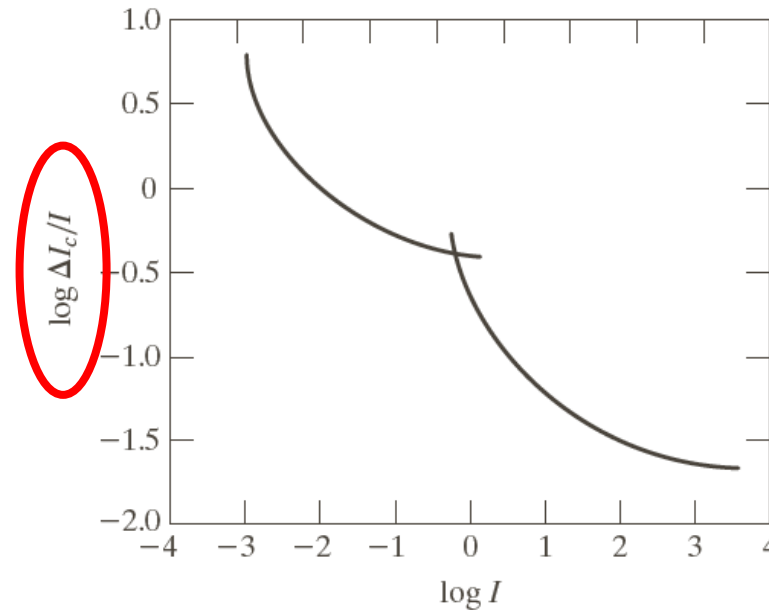


FIGURE 2.6 Typical Weber ratio as a function of intensity.



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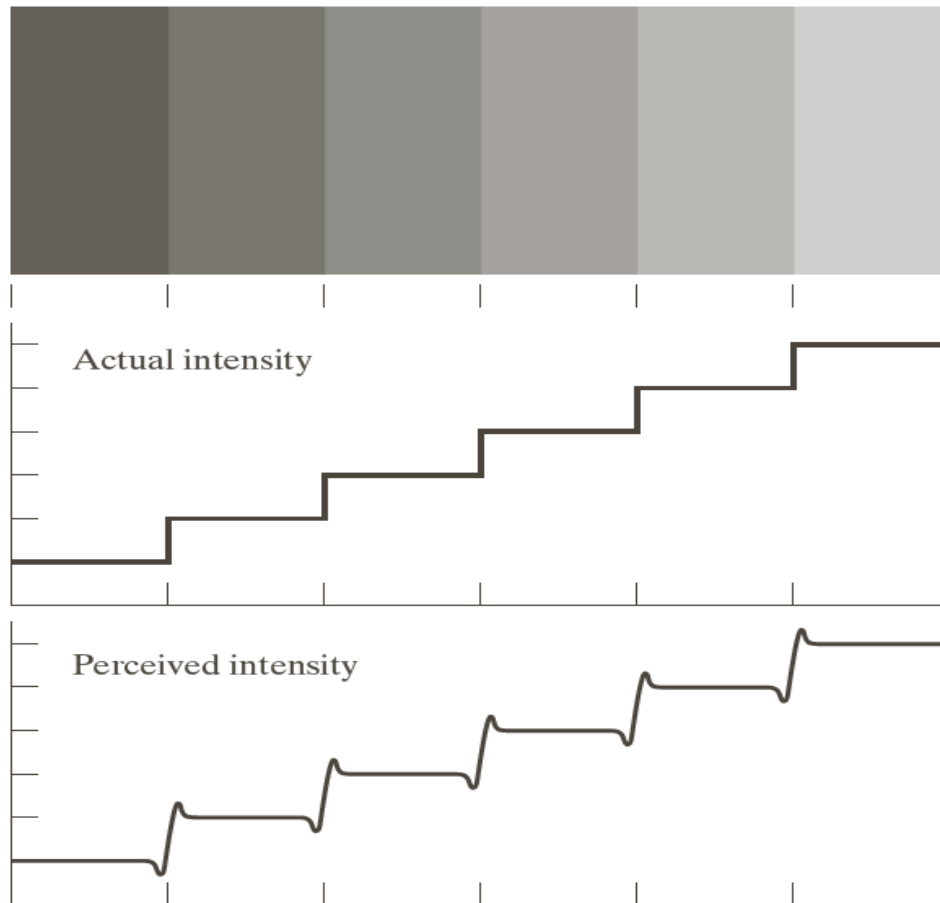
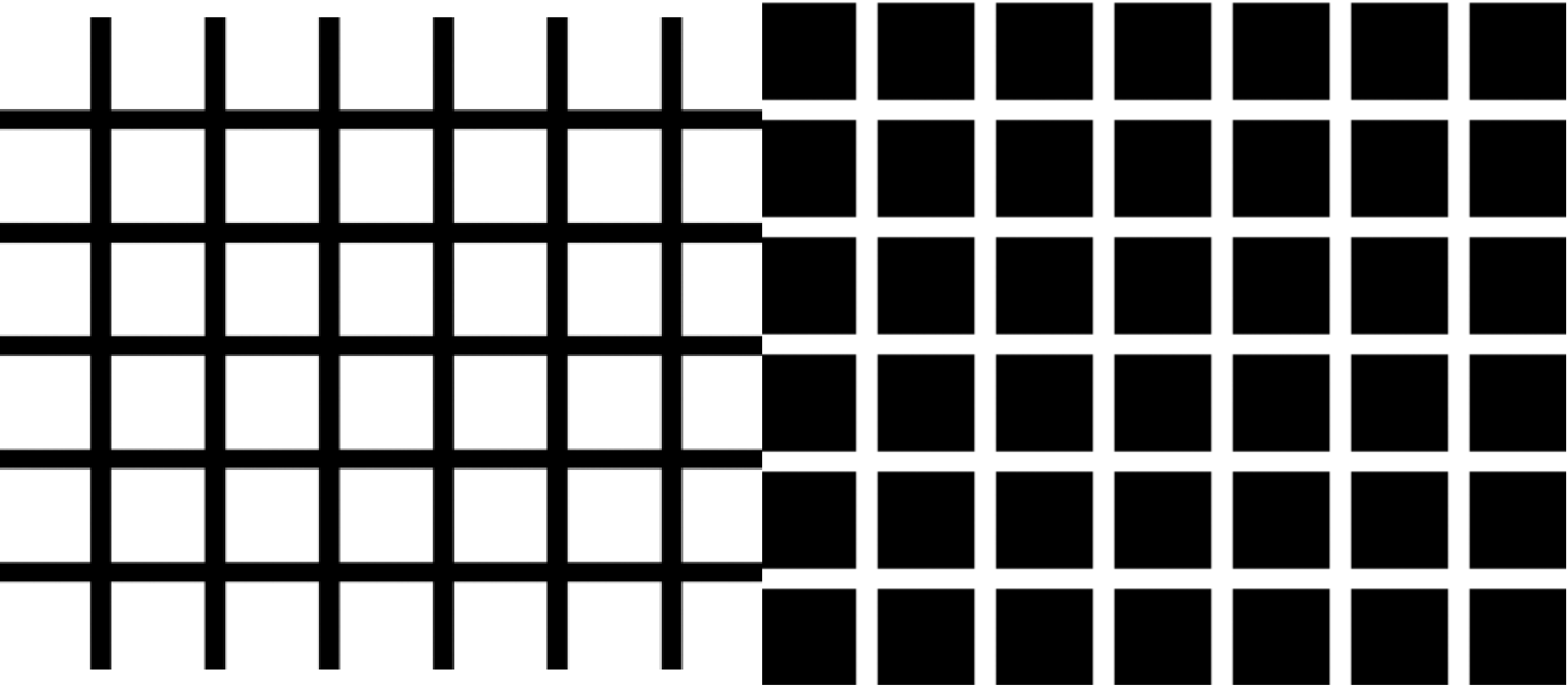


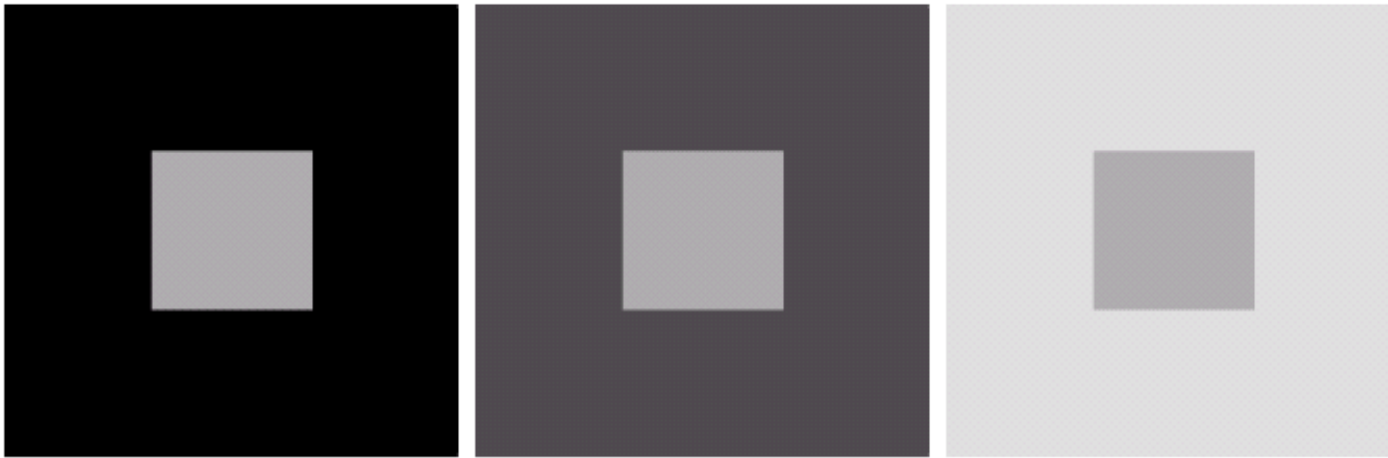
Figure 2.7: Perceived intensity is not a simple function of actual intensity





Characteristics of Human Visual System

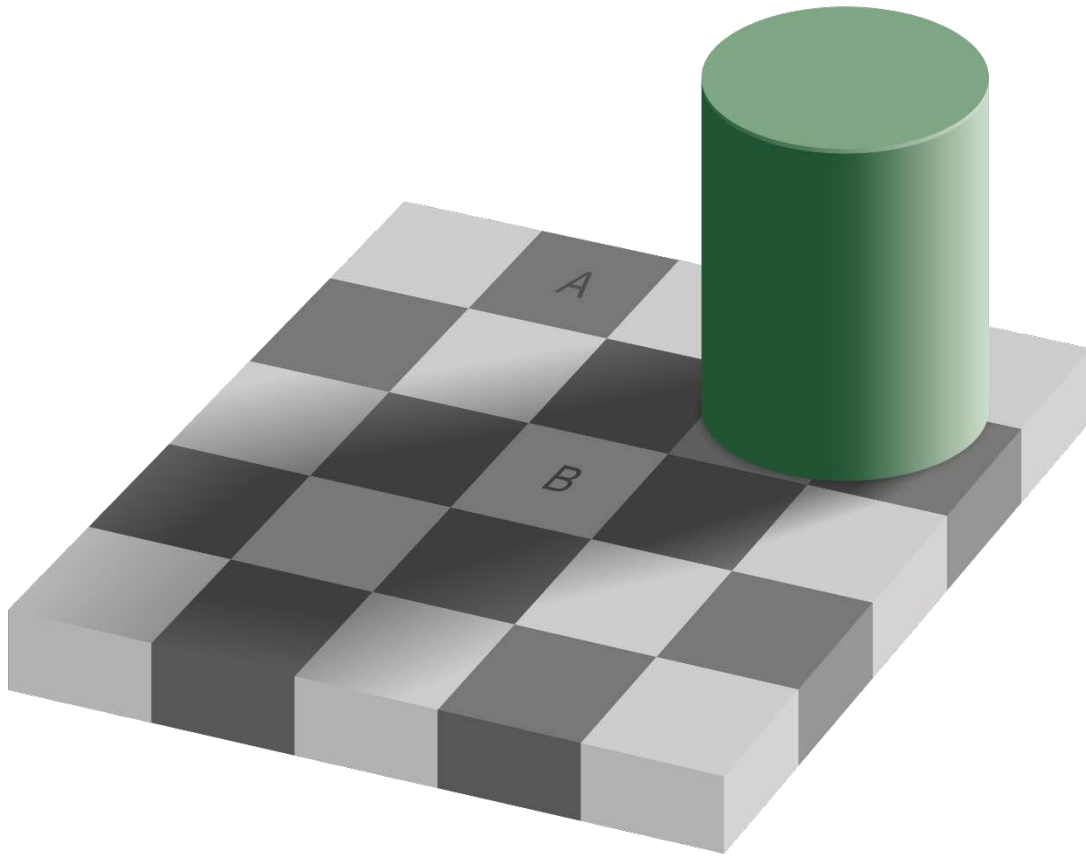
- Brightness adaption
- **Simultaneous contrast**
- Mach band effect
- Optical illusion



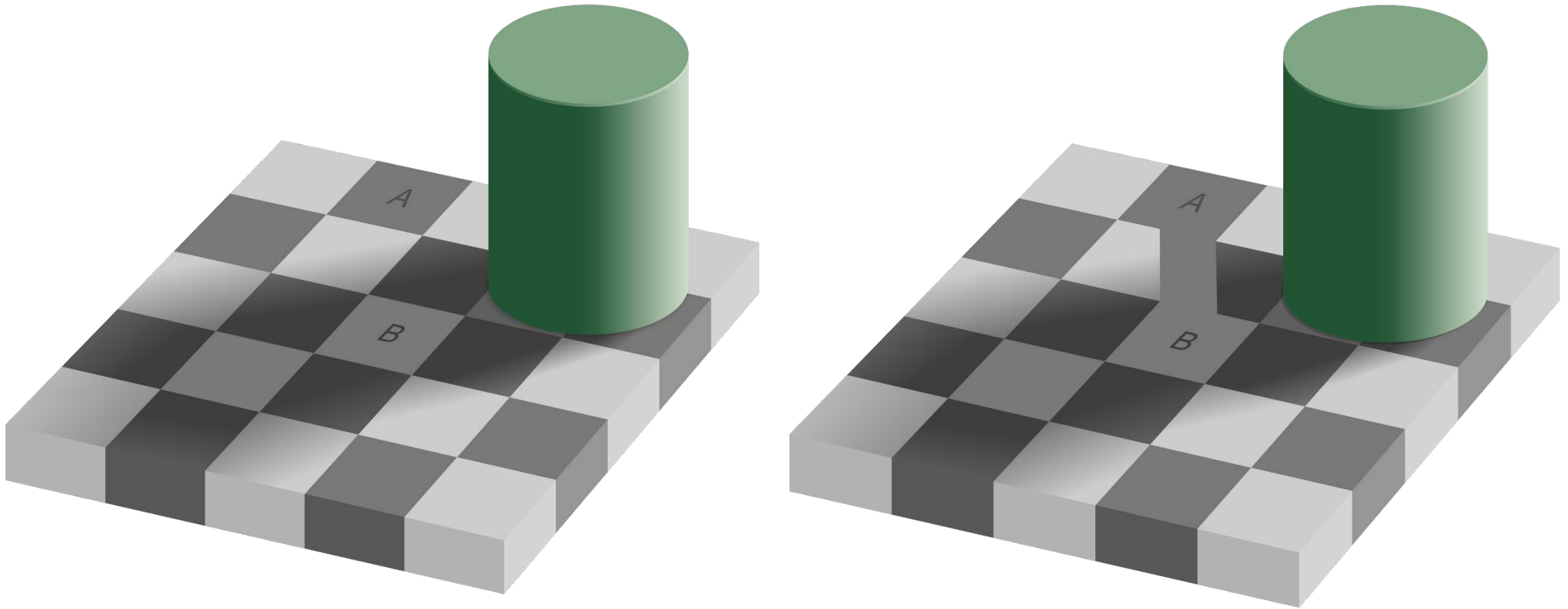
All the inner squares have the same intensity,
but they appear progressively darker as the background becomes lighter

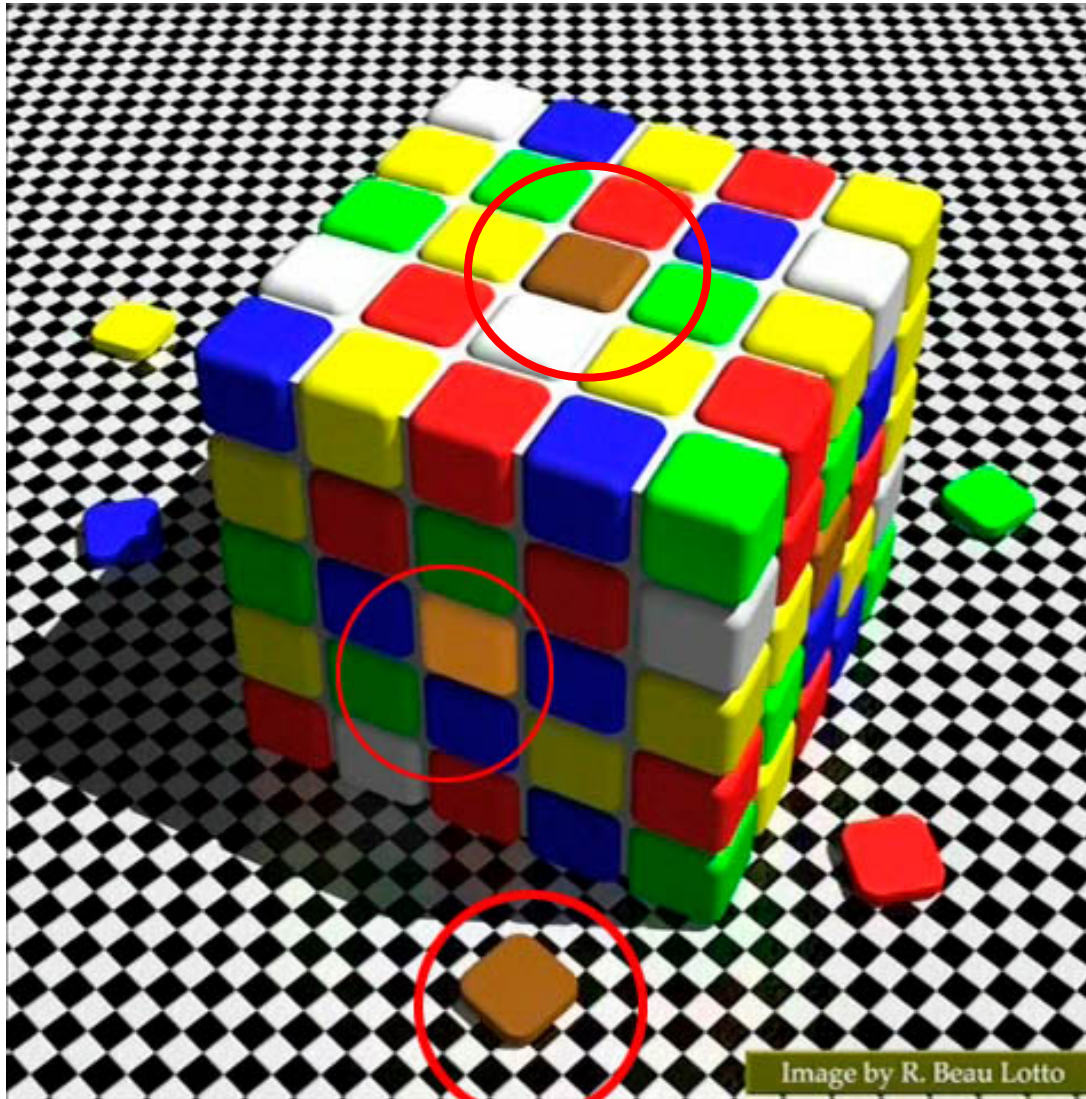


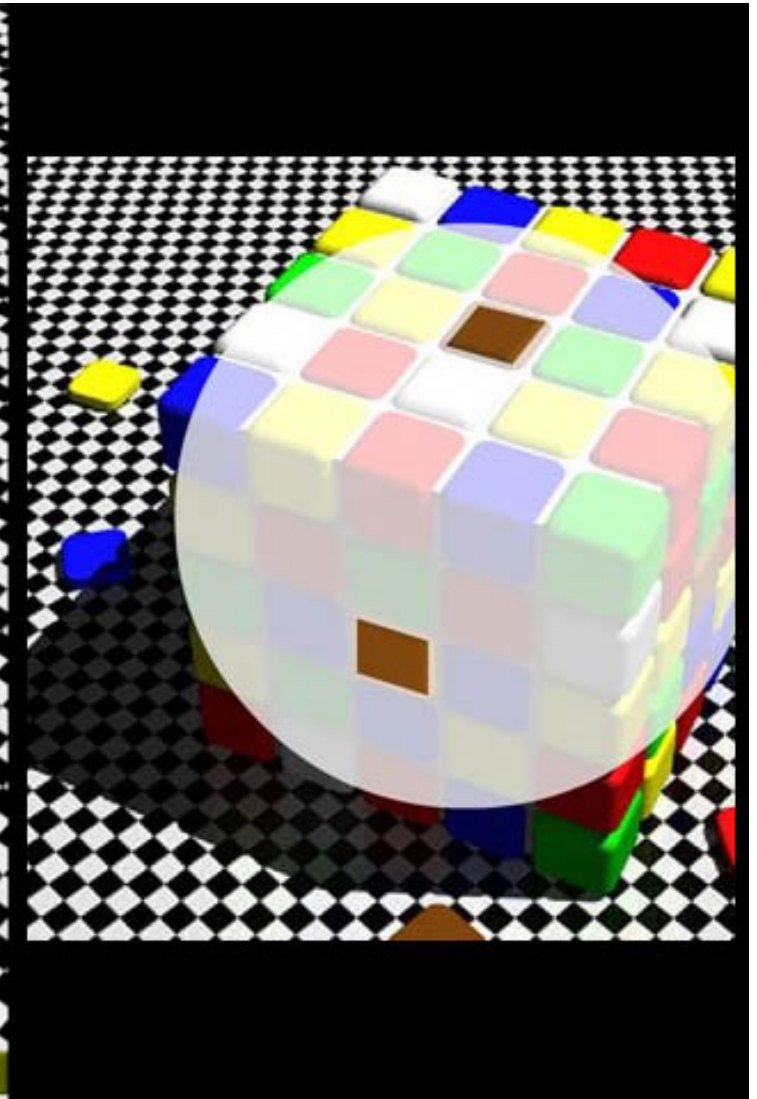
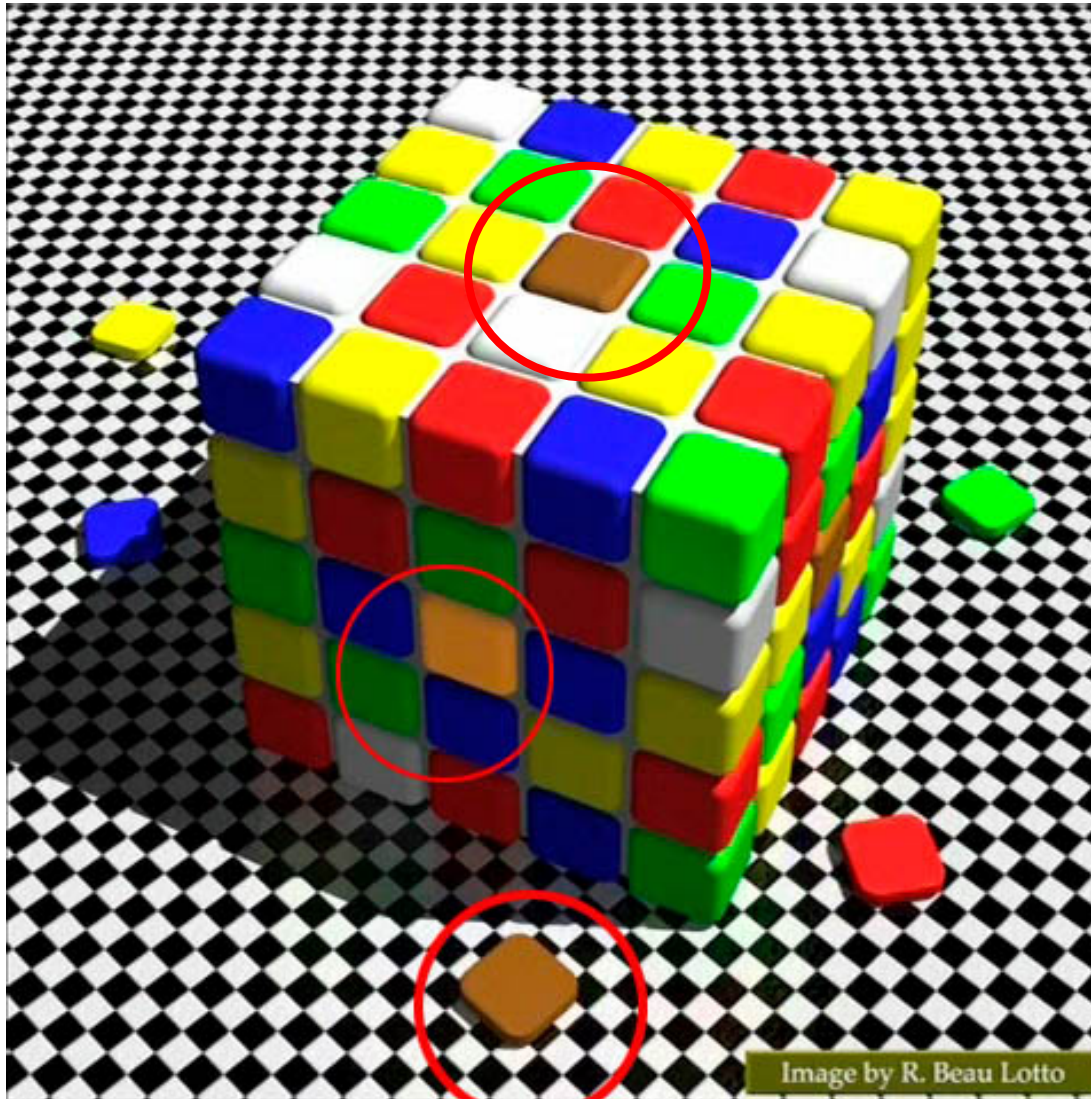
Checker shadow illusion



Checker shadow illusion

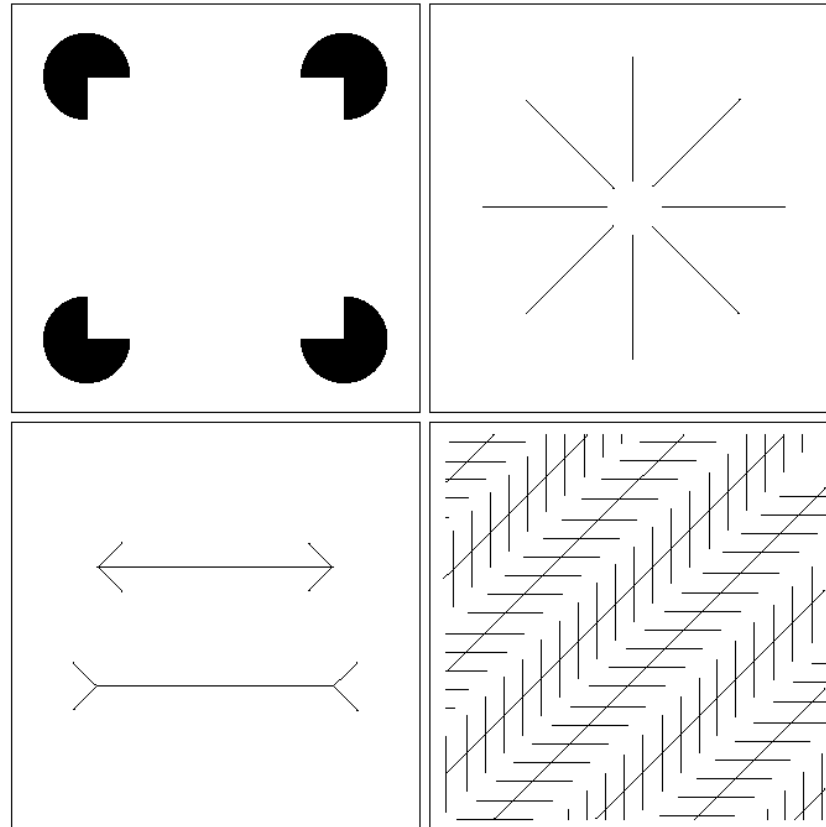


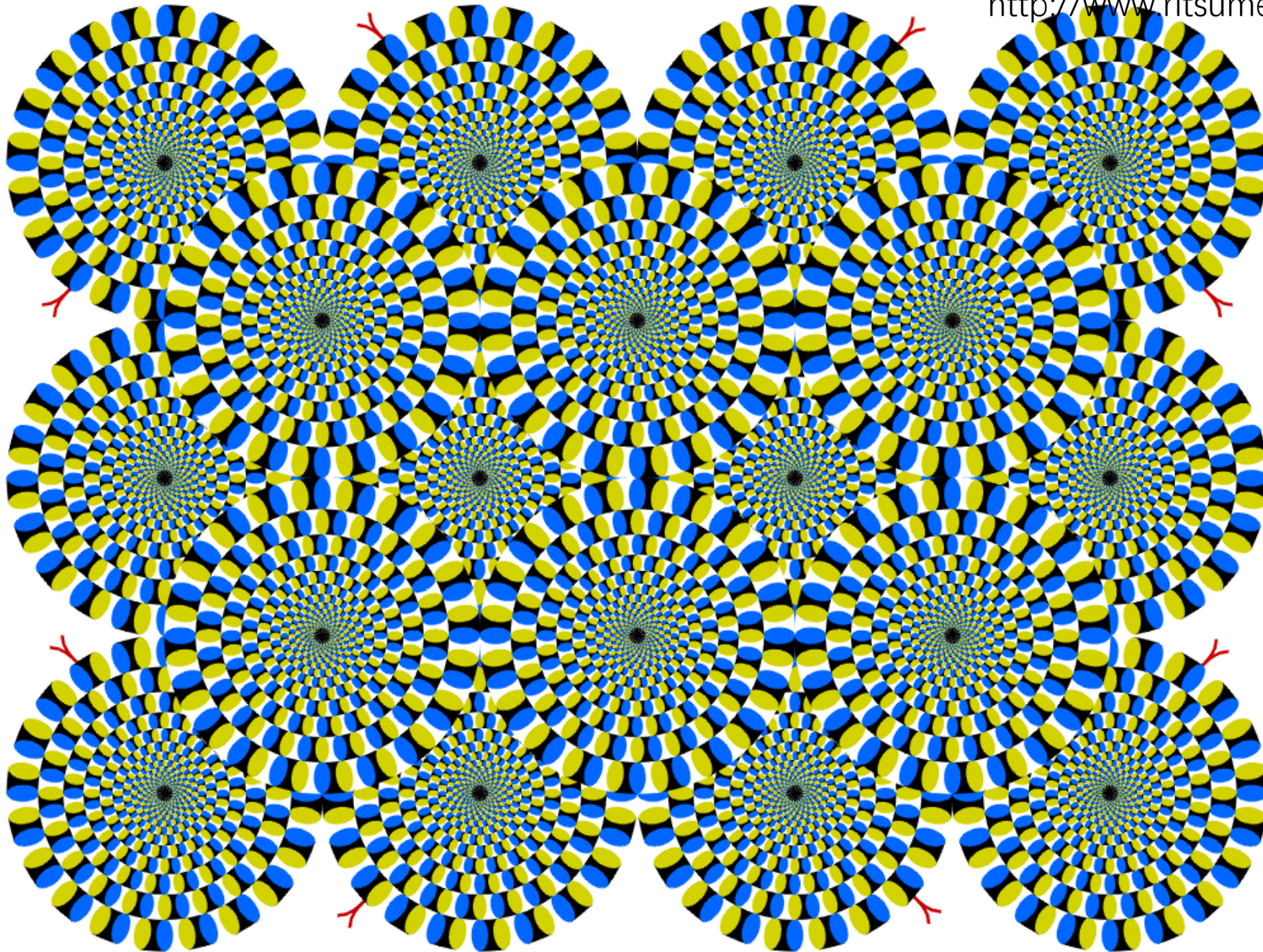


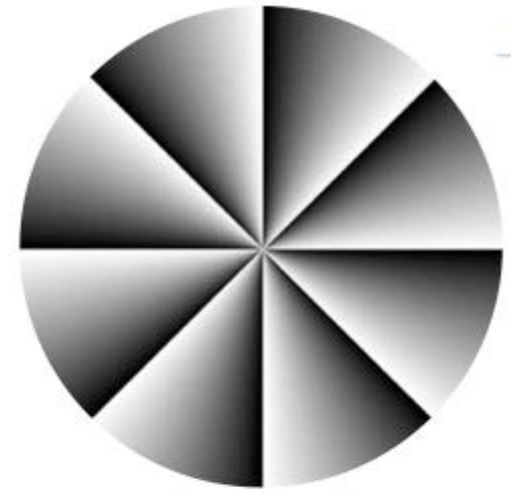
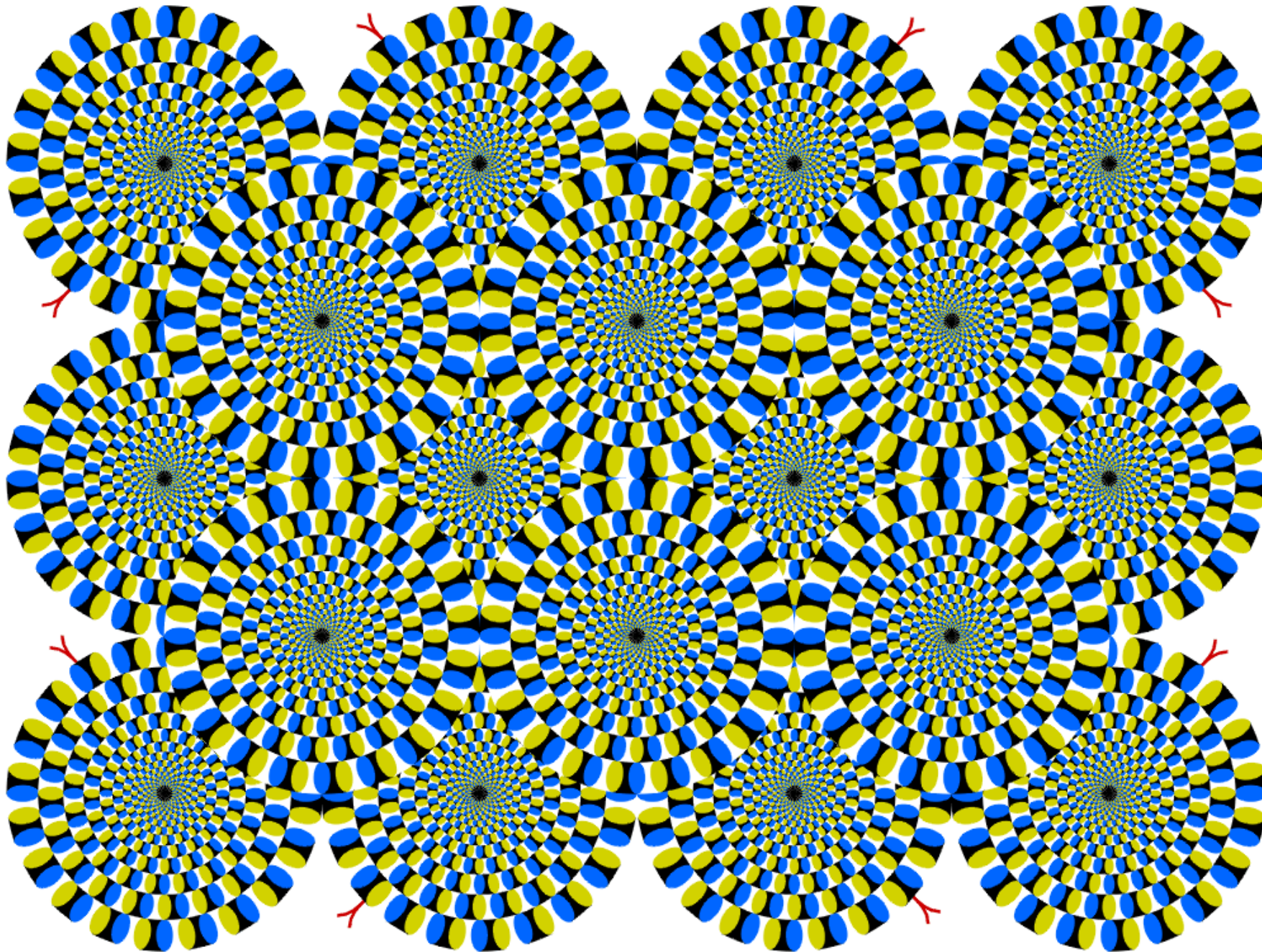


Characteristics of Human Visual System

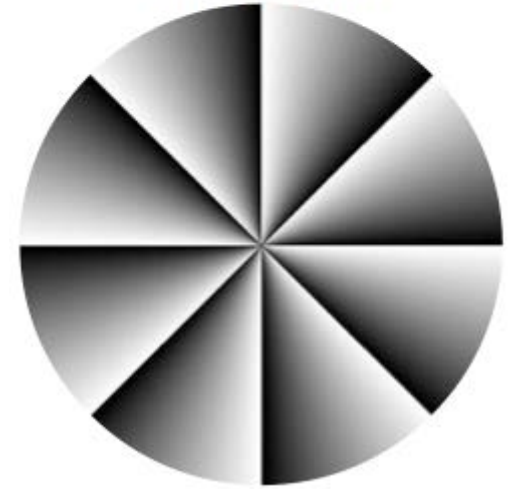
- Brightness adaption
- Simultaneous contrast
- Mach band effect
- **Optical illusion**







What do you see when you read this?
Do you see motion in the images above and below?
(If not try blinking rapidly while fixating here - • • •)
If so, do they move in the same direction?
Is the motion consistent with the luminance profile?



Gender illusion



Your eyes can do more than you think...

- McGurk effect
 - <https://www.youtube.com/watch?v=G-IN8vWm3m0>
 - <https://www.youtube.com/watch?v=jtsfidRq2tw>
- Rubber hand illusion
 - <https://www.youtube.com/watch?v=DphlhmtGRql>



Take home message



- Be careful of your brain, it might be alien...

